FEBRUARY 27, 1956 50 Cents

AVIATION WEEK

A McGRAW-HILL PUBLICATION

Airpower Budget Request Fight Flares in Capital

Congress Probes Aircraft Profits

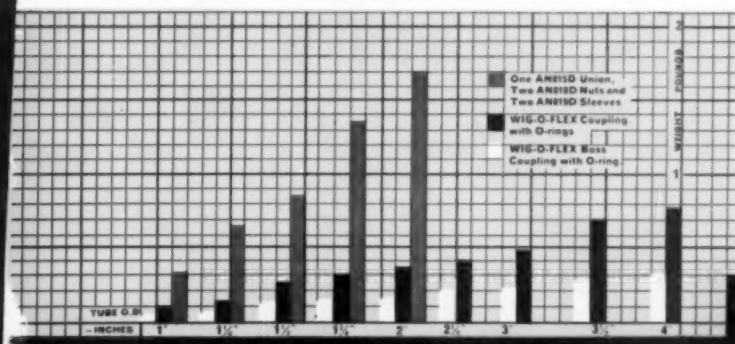
Are You Interested In WEIGHT REDUCTION?

WIGGINS COUPLINGS SAVE 88 POUNDS ON LOCKHEED C-130

America's first turbo-prop transport—the Lockheed C-130—is 88 pounds lighter because WIG-O-FLEX Couplings replaced standard AN connections and cut hose. WIG-O-FLEX Couplings weigh 1/5 as much as the standard AN connections they can replace. (See Weight Chart for exact comparisons.)

WIG-O-FLEX® COUPLING

flexible union for connecting rigid tubes



WEIGHT COMPARISON CHART
WIG-O-FLEX COUPLING & AN STANDARD FLARED TUBE CONNECTION

- Withstands more than 1000 psi burst pressure.
- Accommodates 4° tube flexure.
- Installs locally. 80% lighter.
- Temperature range —65°F to +250°F.

Sizes: 1", 1¼", 1½", 1¾", 2", 2½", 3", 3½", 4"

WRITE FOR FURTHER INFORMATION

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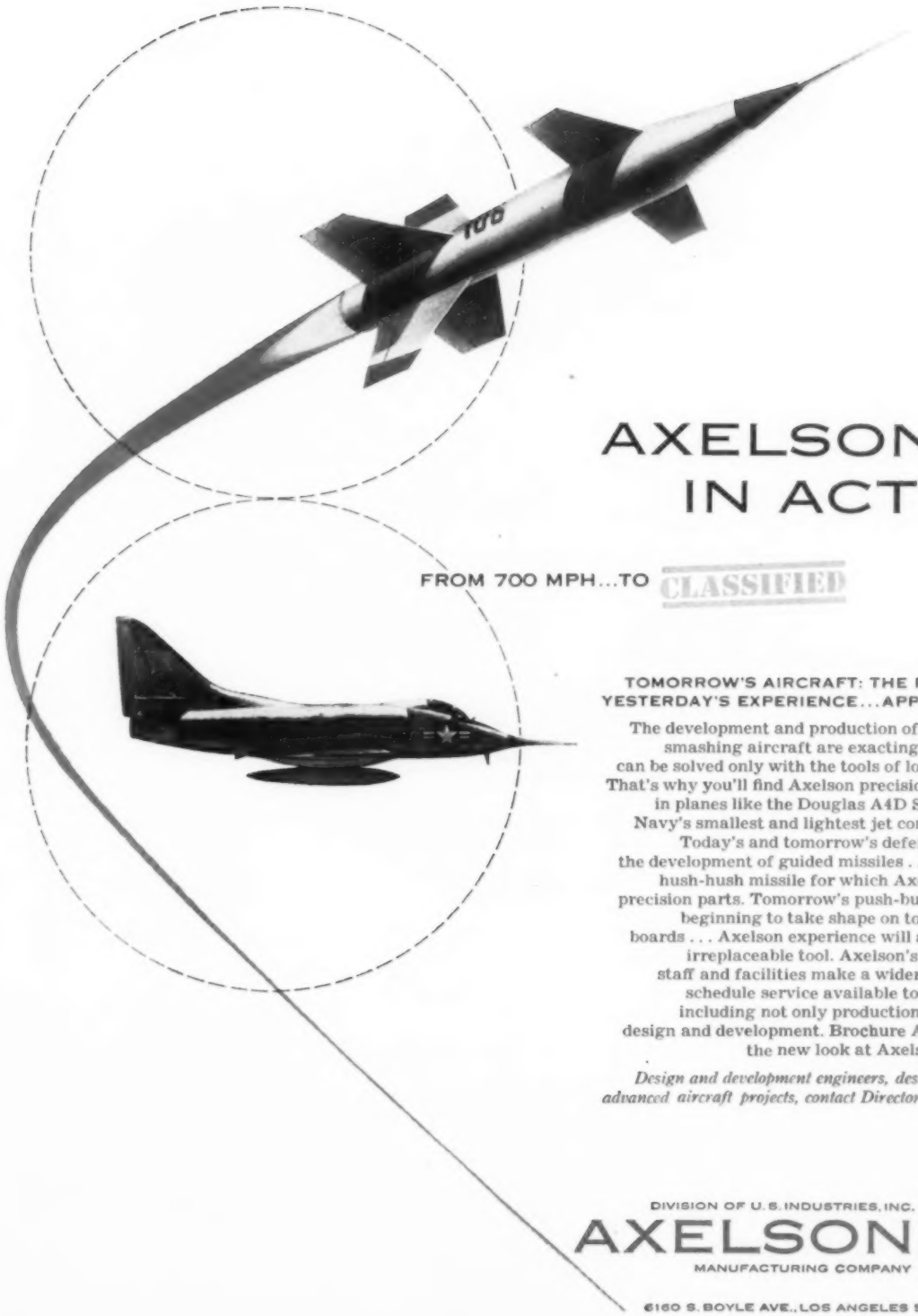

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FROM 700 MPH...TO CLASSIFIED

TOMORROW'S AIRCRAFT: THE PRODUCT OF YESTERDAY'S EXPERIENCE...APPLIED TODAY.

The development and production of today's Mach-smashing aircraft are exacting problems that can be solved only with the tools of long experience. That's why you'll find Axelson precision components in planes like the Douglas A4D Skyhawk —the Navy's smallest and lightest jet combat airplane. Today's and tomorrow's defense is linked to the development of guided missiles . . . ones like the hush-hush missile for which Axelson produces precision parts. Tomorrow's push-button arsenal is beginning to take shape on today's drawing boards . . . Axelson experience will again prove an irreplaceable tool. Axelson's new, enlarged staff and facilities make a wider variety of on-schedule service available to the industry—including not only production, but research, design and development. Brochure AW2 describes the new look at Axelson. Ask for it!

Design and development engineers, desiring to work on advanced aircraft projects, contact Director of Engineering.

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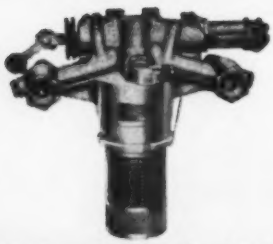
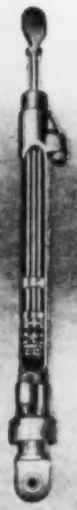
Strut Assembly–
Main Landing Gear Retract



Valve Assembly–Steering Metering

Spoiler Valve

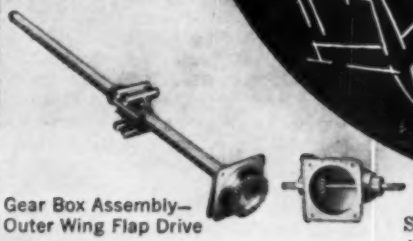


Pneumatic Door Lock

High Heat Treat
Strut Assembly

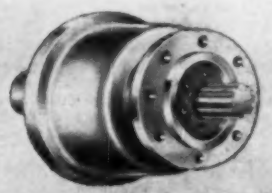
Sargent

HYDRAULIC, PNEUMATIC, AND MECHANICAL AIRCRAFT CONTROLS



Gear Box Assembly–
Outer Wing Flap Drive

Gear Box



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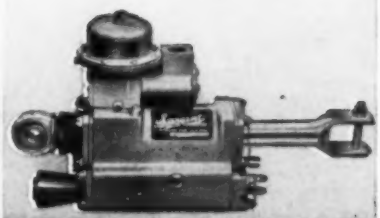

Unit Assembly–

Standard of Excellence Sargent *Since 1920*

"Good will" is the disposition of the pleased customer to return to the place where he has been well treated.
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AVIATION CALENDAR

Mar. 6-8—Fourth Annual Air Line Pilot's Association, Air Safety Forum, Shoreland Hotel Chicago.

Mar. 14-16—1956 Aviation Div. Conference of the American Society of Mechanical Engineers, Beverly-Hilton Hotel, Los Angeles, Calif.

Mar. 15-17—National Aviation Educational Council, annual conference, Hotel New Yorker, New York.

Mar. 19-21—Society of Automotive Engineers, national production meeting and forum, Hotel Statler, Cleveland, Ohio.

Mar. 19-22—Institute of Radio Engineers, national convention, Waldorf-Astoria Hotel & Kingsbridge Armory, New York.

Apr. 2-4—American Institute of Electrical Engineers, South West District Meeting on "Electricity in Aircraft," Baker Hotel, Dallas, Texas.

Apr. 9-12—Society of Automotive Engineers, national aeronautic meeting, aeronautic production forum and aircraft engineering display, Hotel Statler, New York, N. Y.

Apr. 10-11—Symposium for Management on Application of Analog Computers, sponsored by Midwest Research Institute, University of Kansas City, Kansas City, Mo.

Apr. 18-19—First Annual National Industrial Research Conference, sponsored by Armour Research Foundation, Hotel Sherman, Chicago.

Apr. 19-20—Annual Meeting of the Science Section of the Environment Equipment Institute, Sheraton Hotel, Chicago.

Apr. 22-26—American Association of Airport Executives, 29th annual convention, Hotel Carter, Cleveland, Ohio.

Apr. 30-May 4—Society of Aeronautical Weight Engineers, 15th national conference, El Cortez Hotel, San Diego.

May 2—Society of Aeronautical Weight Engineers, 14th annual conference, Fort Worth, Tex.

May 2-3—Air Traffic Conference of the Air Transport Assn., Hotel Radisson, Minneapolis, Minn.

May 2-5—Twelfth Annual National Forum of the American Helicopter Society, Sheraton-Park Hotel, Wash., D. C.

May 3-4—Sixth Annual Institute of Aeronautical Sciences, West Coast Student Conference, Los Angeles.

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They cost less to install and fewer do the job . . . better!

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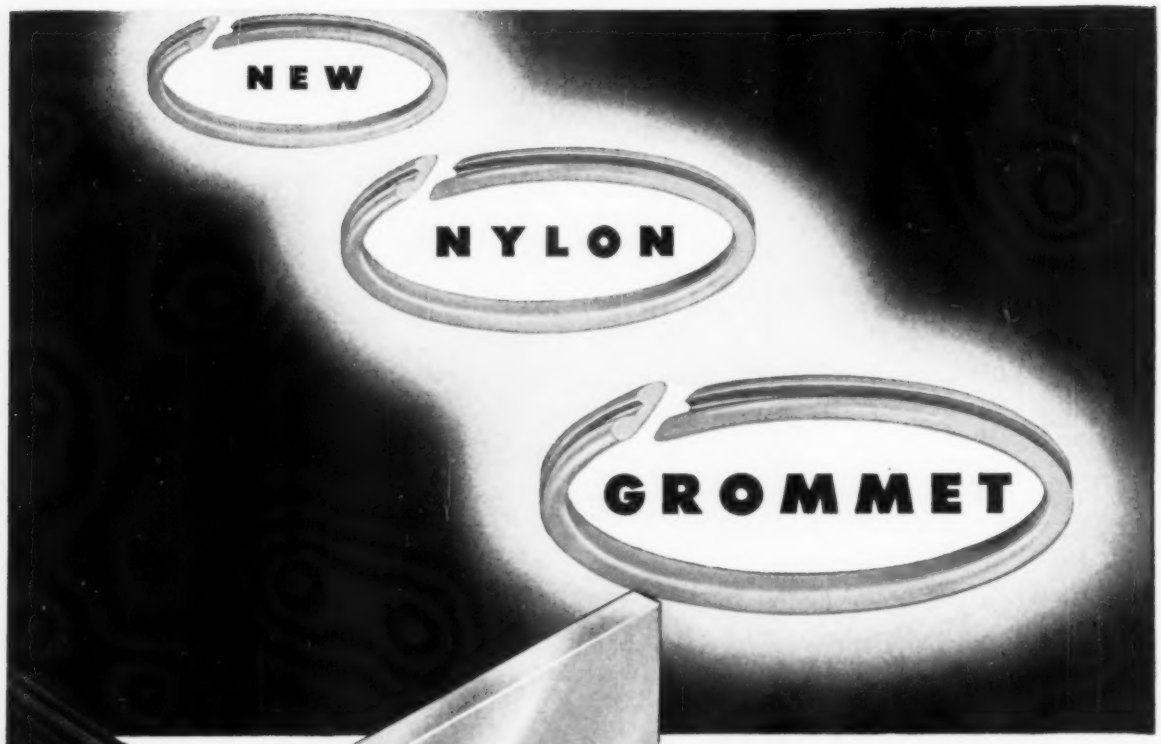

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Will withstand unusually high temperatures without loss of useful characteristics.

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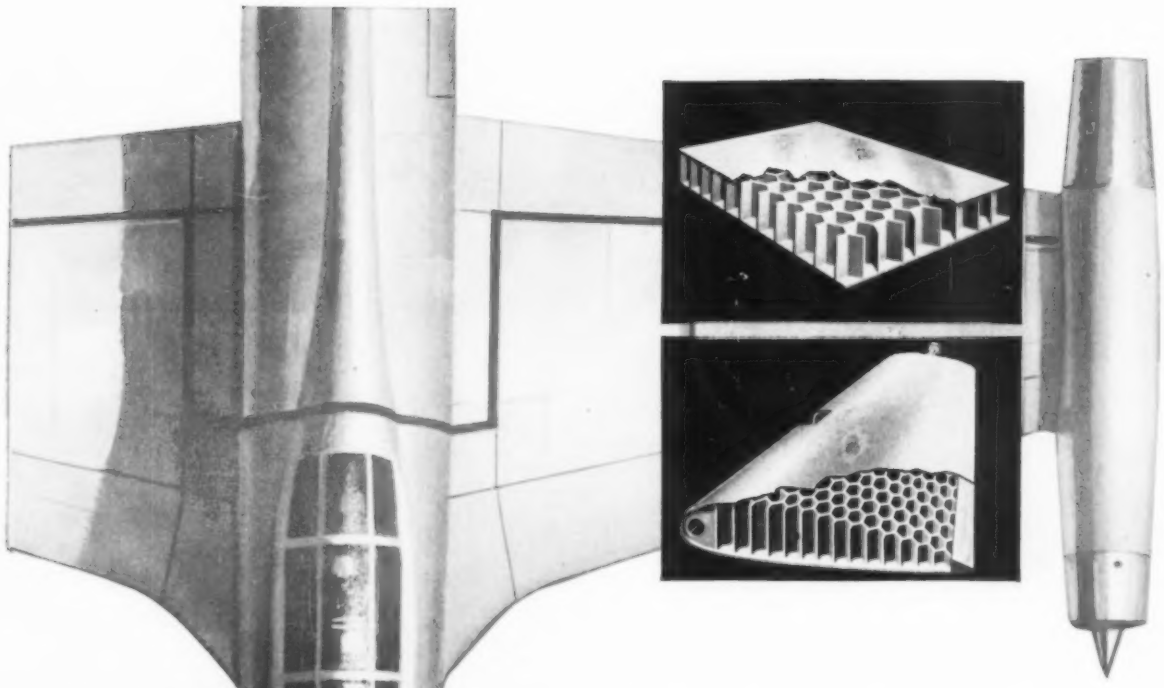

KAWNEER METAL BONDING FACILITIES *for assemblies*

with IMPROVED FATIGUE-LIFE, HIGHER STRENGTH and LOWER WEIGHT

The use of honeycomb and metal bonded construction has become a necessity for the successful solution of many airframe problems. The pounds saved in floor construction and bulkheads for commercial airliners mean additional range and revenue. The aerodynamic smoothness of external surfaces means more knots, less power, better control, and longer range. The rigidity and light weight can reduce flutter and balance problems while the elimination of stress-raising fasteners minimizes fatigue. Kawneer can be your reliable source for honeycomb and bonded construction.

Kawneer is producing a wide variety of flat and contoured honeycomb assemblies for the airframe industry. In addition to complete sheet metal forming and fabricating facilities, Kawneer has metal bonding equipment that is capable of 650°F. and 200 lbs. per sq. in. which will handle adhesives for higher temperature applications required for future higher speed aircraft. Typical assemblies currently in production for most of the major aircraft producers are trailing edges, airfoil contour trim tabs, floor panels, flight deck tables, access doors and panels and large, contoured wing panels. Kawneer is capable of assisting you in simple or complex, large or small, flat or contoured, organically bonded honeycomb or metal bonded assemblies.

Our engineers can work with you in your design and production problems. Please write, wire or phone.

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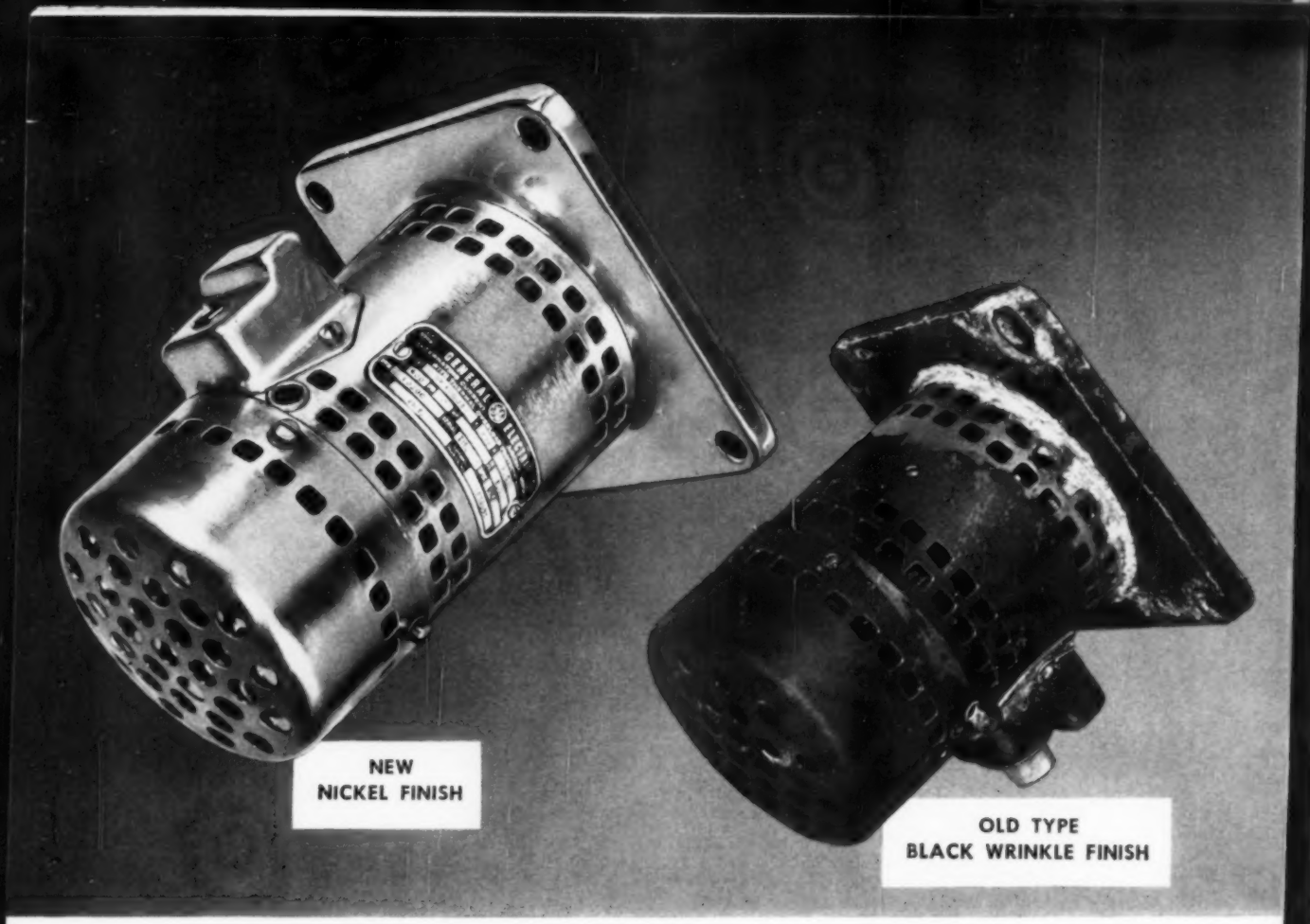

NICKEL FINISH on G-E Aircraft Motors Now Eliminates "Paint Flaking" Problem

Supersonic speeds of today's guided missiles mean split-second temperature changes—from +165 F to −70 F in twenty seconds, for example. Thermal impact such as this "pops off" ordinary black wrinkle finish on missile system component motors. And "popped off" flakes can damage intricate speed, directional, or detonating controls to cause missile failure. That's why General Electric now standardizes on nickel finish on G-E aircraft motors—a finish that won't "pop off" even under the most tremendous thermal impact.

Nickel finish is just one of the many extra design features standard on G-E aircraft motors. Others include Mylar* insulation, newly developed Alkanex† wire, special bearing lubrication, stainless steel shafts and unusual protection against radio interference radiation.

Superior design is only a part of the complete G-E story on aircraft motors. The industry's most experienced application engineers, unexcelled testing laboratories, and modern manufacturing facilities all add up to on-time delivery of the right G-E aircraft motors for your application.

FOR PROMPT ATTENTION, contact your local G-E Apparatus Sales office early in your planning. Or write for descriptive Bulletin GEA-6217 to Section 634-2, General Electric Co., Schenectady 5, N. Y.

* *DuPont trade-mark for polyester film.*
† *Trade-mark applied for by the General Electric Co.*

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Main rotor transmission for Sikorsky S-58 Helicopter

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Solar builds world's largest wind tunnel bellows

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4–Canopy Seal Regulator with built in solenoid and relief valve.

5–High Pressure Regulator used in connection with thermal anti-icing system involving high air flow rates.

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Consult your Janitrol district aircraft engineering representative for help with your pneumatic control problems.

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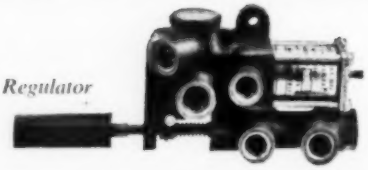
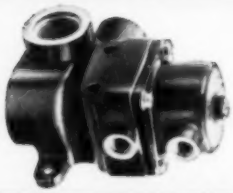
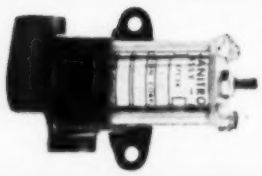


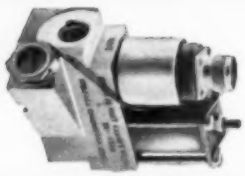
2. *Pylon Tank Regulator*



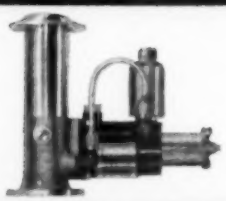
3. *General Purpose Regulator*



4. *Canopy Seal Regulator*



5. *High Pressure Regulator*



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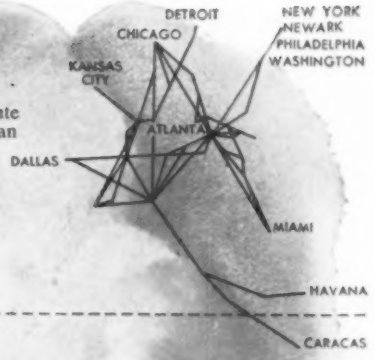
Along the important new Delta route to New York—linking the Caribbean area and the fast-growing South and South West with metropolitan Northeast . . . to points East, West, North and South . . . Delta Air Lines' fleet will fly with Collins Weather Radar.



Delta Air Lines CHOOSES Collins WEATHER Radar

To select smooth, direct flight paths avoiding storm areas, Delta Air Lines' DC-7's, DC-6's and Super Convairs will be equipped with Collins Weather Radar. Installation of Collins Radar is part of Delta's overall equipment and route expansion program. The Delta fleet will be completely equipped with Collins navigation and communication equipment, including Collins newly designed Selcal (Selective Calling System) and ADF (Automatic Direction Finder).

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Elegance

THE PRIDE OF EASTERN... PROTECTED BY SINCLAIR

Elegance is the word for Eastern Air Lines' new Golden Falcon DC-7B's. Every feature of these aircraft has been designed for luxury aloft – from new sound-proofing and seating arrangements to specially woven fabrics. Speed, too, is a Golden Falcon's forte as evidenced by the fact that the Falcon's 4 engines delivering 13,000 H.P. are slicing flight time from Eastern's schedules.

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FEBRUARY 27, 1956

AVIATION WEEK

VOL. 64, NO. 9

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AVIATION WEEK • FEBRUARY 27, 1956 • Vol. 64, No. 9
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RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER

Rubber "boots" on new KB-50 give TAC a longer stride

FIGHTERS AND BOMBERS of the Tactical Air Command rely on the new KB-50 tanker to double their stride on long-range missions. To make sure mid-air refueling goes smoothly—in spite of icing conditions—Hayes Aircraft Corp. uses B. F. Goodrich electrically heated rubber in modifying B-50s for tanker service.

B. F. Goodrich heated rubber "boots" (above) on KB-50 air intakes keep ice from choking off vital air to the reel oil coolers and hydraulic fluid coolers.

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EDITORIAL

Twining, Quarles Confirm Airpower Budget Fraud

The full scope of the airpower budget fraud being perpetrated on the American people in the Fiscal 1957 federal budget was revealed in testimony before the Senate Armed Service Committee by Gen. Nathan F. Twining, USAF Chief of Staff, and Donald A. Quarles, Secretary of the Air Force.

There can be no doubt after Gen. Twining's detailed and forthright testimony that the Fiscal 1957 airpower budget as it has been presented to the Congress will doom this country to protection by a second rate Air Force. Secretary Quarles told essentially the same story in milder and more hopeful terms.

Gen. Twining is a good soldier. In that role he must obey the budget orders from his five star commander-in-chief in the White House. As a Republican appointee to two top level Defense Department posts, Secretary Quarles too feels disciplinary pressure from his political superiors. Both men must formally support the Fiscal 1957 budget before the Congress or resign their jobs in protest as did Trevor Gardner, former USAF Assistant Secretary for Research and Development (AW Feb. 13, p. 28).

But both Secretary Quarles and Gen. Twining have left no doubt that, while they must formally support this budget and will have to live with it if it is not changed by Congress, it does not meet the needs of the Air Force for maintaining its superiority in the face of the increasingly intense and effective competition from the Russians.

In his detailed evidence presented to the Senate Armed Services Committee, Gen. Twining documented all of the major charges made by AVIATION WEEK in its editorial, "The New Airpower Budget Fraud" of Jan. 23, when we sounded the first alarm on the dangers inherent in this program. Here is what Gen. Twining emphasized to the Senators:

• **Production**—The Russians have already produced a much larger total air force than USAF. They already have more Bison heavy jet bombers than USAF has Boeing B-52s and are continuing to outproduce us in this category. They have outproduced us in the light bomber and supersonic fighter categories and will surpass USAF in intercontinental-range bombers and all-weather fighters in the next two years if the present relative pace is maintained. Only in the medium-range jet bomber and transport categories do we stand any hope of maintaining superiority.

• **Technical development**—Gen. Twining echoed warnings by his vice chief of staff, Gen. Thomas D. White (AW Feb. 20, p. 31) Trevor Gardner (AW Jan. 30, p. 21), his top technical commander, Lieut. Gen. Thomas Power, chief of the Air Research and Development Command (AW Jan. 23, p. 31) and AVIATION WEEK (Jan. 2, p. 13 and Jan. 9, p. 21) that the Russians are overtaking USAF in technical development at an alarming rate. Gen. Twining's testimony left little doubt that an accelerated research and development program is an absolute necessity to maintain USAF superiority.

• **Combat-readiness**—Heavy cuts in operations, maintenance and base construction funds imposed by the Fiscal 1957 budget will reduce the combat readiness of USAF. Gen. Twining said it would not make much sense to invest heavily in aerial weapons if the necessary funds to organize and train combat units in efficient use of their weapons were withheld.

• **Strategic Air Command**—Main point of the Defense Department support of the Fiscal 1957 airpower budget is that it will maintain and expand the long-range atomic striking force that has been the backbone of U. S. foreign policy for the past 10 years. Gen. Twining's testimony made it clear that Strategic Air Command's superiority over its potential enemies will decline under this budget. He confirmed for the Senators that the Russians now have a turboprop bomber with intercontinental-range and performance superior to the B-36. This eliminates a former monopoly enjoyed by SAC. Twining detailed how Russia's all-weather defensive forces are getting stronger and how the Russians are already outproducing us in the heavy jet bomber class. Gen. Twining also detailed the Russian air base expansion program in contrast to our own, which crowds several SAC wings onto a single base where they can be wiped out by a single atomic bomb. Dispersal, he said, is the key to survival in the atomic age. But the budget does not provide enough money to continue the SAC dispersal program.

Both Gen. Twining and Secretary Quarles told the Senate Committee that "substantial" increases in USAF's Fiscal 1958 budget will be necessary for research, development, procurement, base construction, operations, maintenance and increased pay for skilled technicians. What they are really saying is that the "austere" Fiscal 1957 budget is a political expediency that postpones the day of real financial reckoning for airpower until after the 1956 election and that this process will cost us another year of irretrievable time in the race with the Russians.

Herein lies the essence of the new airpower budget fraud. The Fiscal 1957 budget is being presented as a strong airpower budget when virtually all of the people presenting it know that it does not meet the minimum airpower needs by about $2.5 billion. They are trying desperately to conceal the true story of this new airpower fraud by a campaign of adroit distortion, manipulation of military security regulations and deliberate half-truths.

If the American people are given the truth on our airpower situation and its Russian competition they will make sound decisions to preserve the future of their country as a free nation. But they cannot make these decisions when the facts are hidden behind a cloak of military and political censorship.

To Trevor Gardner, who had the courage to resign his important post in protest against these policies;

To Gen. Nathan F. Twining, who had the courage and skill to balance his soldier's duty with his responsibilities to his country and tell the truth to the Congress;

To Secretary Donald Quarles, who supported Gen. Twining on Capitol Hill and honestly admitted there were no real savings in the Fiscal 1957 budget but only deferred payment until 1958;

To all these men, the American people owe a sincere vote of thanks for providing the facts on our military airpower.

—Robert Hotz

Left to right, from top to bottom: McDonnell F-101; North American F-100; Convair F-102A; Boeing B-52; North American FJ-4, F-86D, and F-86H; Lockheed C-130; Douglas DC-7; Sikorsky S-56 and S-58.

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WHO'S WHERE

In the Front Office

Delos W. Rentzel, president, Slick Airways, retaining his post as board chairman. **Herman Ruppel**, treasurer.

J. G. (Gil) Nettleton, Jr., vice president-assistant to the president, Radioplane Co., Inc., Van Nuys, Calif.

Gordon M. Bain, vice president-sales, Northwest Orient Airlines, former executive vice president of Slick Airways.

Richard W. Harbison, vice president in charge of Dayton, Ohio, operations, Cook Electric Co., Chicago, Ill.

Charles D. Manhart, assistant to the president, coordinating aircraft sales for Bendix Aviation Corp. divisions. **Karl F. Kellerman**, associate director, Systems Planning Group, Bendix Aviation Corp. and **Prof. Robert F. Reinhart**, Case Institute of Technology, consultant. **Richard S. Finke**, executive aviation sales supervisor, Bendix Radio.

F. H. Guterman, assistant vice president, Arma Division, American Bosch Arma Corp., Garden City, N. Y.

Leonard S. Hermelin, executive assistant to vice president, Fairchild Camera & Instrument Corp. and general manager of Reconnaissance Systems Division.

B. B. Gragg, assistant vice president-sales and public relations administration, United Air Lines; **Homer J. Merchant**, head of the sales department.

J. A. Wellings, general manager, Canadian Steel Improvement, Ltd., Toronto, a subsidiary of A. V. Roe Canada, Ltd., succeeding **C. J. Luby** president-general manager, who resigns effective Mar. 31 to return to England to an aircraft industry post.

Group Capt. R. H. E. Emson, director of Britain's Armament Research & Development (Air), succeeding **Air Commodore H. Ford. Air Commodore Leonard Taylor**, senior staff officer, Maintenance Command, R.A.F., with acting rank of air vice-marshal.

Changes

Dr. George E. McCullough, manager-process development, General Electric Co.'s chemical development department, Pittsfield, Mass.

Emmet E. Baker, Jr., Electronics Division manager, Chamberlain Aviation, Inc., Akron, Ohio.

Dr. Eugene B. Johnston, project engineer-instruments and equipment for medical research and treatment, Wacline, Inc., Dayton, Ohio.

James W. Nelson, Jr., manager and **Dr. William A. Edson**, consulting engineer, General Electric Co.'s Microwave Laboratory, Stanford Industrial Park, Palo Alto, Calif. Nelson succeeds **H. R. Oldfield, Jr.**, recently promoted to general manager, Industrial Computer Section, GE Technical Products Dept., Syracuse, N. Y. **Orville L. Mabee**, materials manager, cathode ray tube plant, Syracuse.

Edward W. Rice, advance planning manager, Trans World Airlines.

Charles W. Tait, liquid propellant research supervisor, contract research department, Wyandotte Chemicals Corp., Wyandotte, Mich.

INDUSTRY OBSERVER

► Douglas Ding Dong air-to-air missile with a nuclear warhead will use a liquid fuel rocket motor being developed by the Rocketdyne Division of North American Aviation, Inc.

► **Boeing Airplane Co. will make its bid for a supersonic bomber with its project 110, utilizing new chemical fuels, rather than on the larger version of the B-52 powered by Pratt & Whitney J75 turbojets. Even with the 15,000 lb. thrust J75 turbojets the B-52 will remain subsonic.**

► Pentagon is taking a new look at the Convair B-58 supersonic bomber program now that it is almost certain the design competition for a new tactical bomber will be cancelled, due to limitations on USAF research and development funds (AW Feb. 13, p. 28). Tactical Air Command teams have been visiting Convair's Ft. Worth, Tex., plant inspecting the B-58 mockup and prototype under construction. Prototype is scheduled to make its first flight next fall.

► **Egyptian air force has received about 30 Il-28 twin-jet light bombers from Czechoslovakia. The Russian-designed planes are being assembled at Almaza at the rate of about one per week and about one dozen have been completed to date. The Egyptian air force will be completely dependent on Czech supplies of bombs and ammunition as well as spares.**

► First production model of the Lockheed F-104A, powered by a General Electric J79 turbojet, made its initial flight from Edwards AFB last week.

► **Air Force has successfully tested its ground-to-air "data link" which will enable air defense SAGE computers to automatically direct interceptors into the vicinity of the target, where their own airborne radar can take over for terminal guidance. The USAF "data link" system, developed by General Electric Co. provides only for ground-to-air data transmission. Improved systems, now under development, permit two-way data transmission.**

► An inertial bombing system, which can operate without visual or radar reference to the ground, is under design for the Air Force. The new system, developed by the Massachusetts Institute of Technology, has been turned over to A. C. Spark Plug division of General Motors Corp. for production design.

► **Cessna expects to fly its prototype Model 620 four-engine executive transport in April. Tests on the pressurized fuselage have been completed and major sub-assemblies are nearing completion at Wichita.**

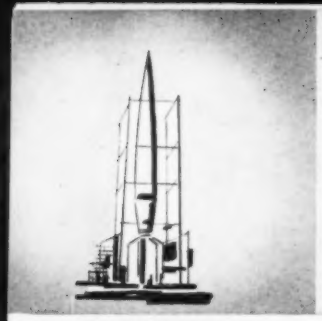
► ARDC has given Technical Program Planning Documents to six manufacturers seeking development of an improved long-range rescue "vehicle." The aircraft would have a helicopter's ability to hover and rise vertically, but forward speed will be far greater than now possible with rotary wings.

► **A Sncase Alouette II helicopter, powered by a Turbomeca Artouste turbine engine crashed and burned in southwest France earlier this month. Cause of the accident has not been determined. Two prototype and three pre-production models of the helicopter have been built. Full production is expected to start in March.**

► Air Force Northrop Scorpions flying out of Kinross AFB, Mich., are reporting service needs while still airborne. The pilot radios by code number the servicing requirements, such as, radar, fuel, engine or instrument, and specialists are on hand with tools ready when the airplane lands.

► **An Air Force evaluation team has inspected Phase One designs for the long-range interceptor competition among North American, Northrop and Lockheed. A decision on competition may come by Mar. 1.**

► Saunders-Roe supersonic interceptor is scheduled to use two de Havilland Gyron junior turbojets and one de Havilland Spectre rocket engine.



MISSILE SYSTEMS

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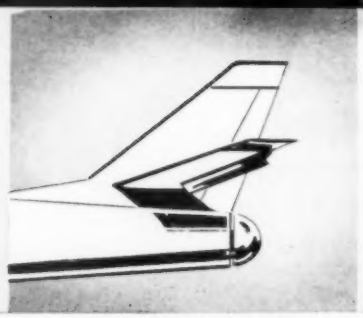

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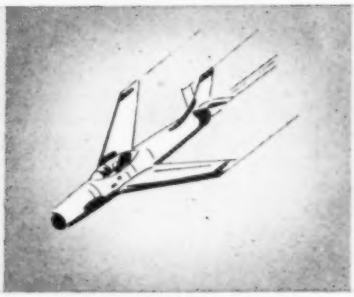

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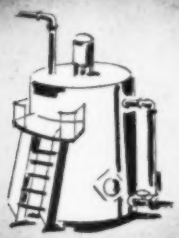

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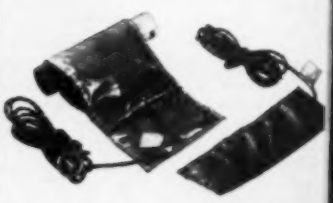

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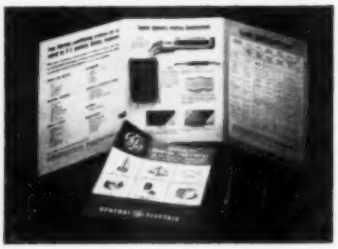

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Washington Roundup

Research Victory

Although Trevor Gardner's request for $250 million more in USAF research and development funds had the support of the Air Staff in addition to distinguished USAF advisors such as Brig. Gen. Charles Lindbergh, Dr. Theodore von Karman and Dr. Guyford Stever, USAF Secretary Donald Quarles vetoed it. Now Quarles is yielding to USAF pressure and has agreed to a project by project review of its research and development projects, and has indicated he will back a request for additional funds. Best guess is that about $80 million will be added to USAF's Fiscal 1956 R&D budget. Some of this will come from Defense Department emergency funds and some is likely to come from a supplemental budget request.

Rothschild's Mistake

Louis S. Rothschild, Commerce Undersecretary for Transportation, said that he personally was to blame for the "leak" on new airport projects totaling $39 million, which had aroused the ire of Democratic leaders in Congress. (AW Feb. 20, p. 25). He admitted at a Senate Commerce Aviation Subcommittee hearing that he gave a list of the airport-aid projects to the Republican Congressional Campaign Committee some 18 hours before it was made public. The list, Rothschild said, was given to William Warren, committee director. The committee works for the election of Republican House members. Most GOP House members were tipped in advance of their Democratic colleagues on the allotments.

"If there was a mistake made, it was mine," Rothschild said in answer to a question from Sen. Mike Monroney (D.-Okla.). "If I'm still around when the same thing comes up again, I'll be a little smarter than I was last time," he added.

Quarles' Detachment

USAF Secretary Donald Quarles, who is having internal problems with the professional military leaders of the Air Staff and some of his civilian assistants over the size of the Fiscal 1957 airpower budget, recently told the House Appropriations Committee:

"I claim for my views a certain amount of detachment from the Air Force rather than looking at it just as an Air Force matter."

Missile Roles

Gen. Nathan F. Twining, USAF Chief of Staff, testified before the House Appropriations Committee that the service responsibility for operating intermediate-range missiles has not been assigned by the Defense Department, although USAF and a joint Army-Navy team have been assigned IRBM development missions. Gen. Twining said USAF had been assigned operational responsibility for the intercontinental ballistic missile (ICBM) and was getting ready to organize combat units trained to use the ICBM as soon as it is available.

Security Snafu

This month's top security snafu, which resulted in first Defense Department release of unclassified photos of Redstone and Snark missiles late last Monday, has resulted in another order from Secretary Charles E. Wilson that probably will result in new annoyances to the aircraft industry. The photos were released to the general press in time to beat a national picture magazine to the newsstands, but not soon enough to prevent loud protests from the Pentagon's regular press corps. A few days earlier, while the Department was trying to make up its mind what to do, Army, Navy and Air Force secretaries were told in a Wilson memo that "all photographs or sketches of new weapons projects, new equipment and new aircraft shall not be declassified by the services, at local commands or headquarters, for release for publication until approved by the Office of Security Review in the Office of the Assistant Secretary of Defense (Legislative and Public Affairs)." Effect of this could be to deny declassification where circumstances make it necessary because of conditions peculiar to an aircraft plant's airport or test facilities. The service secretary, responsible for the contract and classification, could not co-operate with an aircraft company in need of declassification in order to meet an engineering, community, personnel or sales problem.

Honor for Billy Mitchell

The Army, with the approval of the Department of Defense, is backing legislation to confer the rank of Major General on the late Billy Mitchell.

It was 30 years ago—Jan. 26, 1926—that the old War Department issued court martial orders requiring Mitchell "to be suspended from rank, command and duty with forfeiture of all pay and allowances for five years" as an outgrowth of his outspoken advocacy of airpower. Mitchell held the permanent rank of colonel and the temporary rank of brigadier general prior to his resignation Feb. 1, 1926.

Pyle Named CAA Deputy

James T. Pyle, 42, civil aviation advisor to the Assistant Secretary of Navy for Air, has been named Deputy Administrator for Civil Aeronautics. He is slated to join CAA on Mar. 10, three months to the day since Charles J. Lowen moved up to the Administrator's spot from the number two CAA job.

Pyle, like Lowen, is a pilot and a Republican. He was a World War II Navy pilot and has held various administrative posts with Pan American World Airways.

The new combination should give CAA the good, top-level working team that is needed, observers say. Lowen has now gotten the feel of his job and Pyle can step right in as his deputy, being already familiar with the Washington scene and the problems CAA faces.

Lowen says he has found in Pyle the kind of deputy he wanted—one who can step into his job if necessary.

Final selection of a deputy administrator should presage other CAA management changes that have long been advocated. The new aggressive leadership being demonstrated at CAA should substantially improve the morale of the rank and file.

First major re-alignment will be to make air traffic control independent of the Federal Airways. David D. Thomas, deputy director of airways, is the only member of the engineer-maintenance dominated hierachy with traffic control background. It is also expected that the aircraft engineering division, presently headed by W. H. Weeks, will be given separate status from aviation safety.

—Washington staff.

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MCDONNELL F-101A: Gen. Twining believes this USAF fighter would be more than a match for Russia's Bison heavy bomber in the event of war. In above picture, the F-101A carries three Hughes Falcon air-to-air missiles (described, on page 29, by Secretary of the Air Force Donald A. Quarles as one of USAF's two guided missiles in the production stage) and two clusters of folding-fin rockets.

Russians Outpacing U.S. in Air Quality,

USAF Chief of Staff says research and development effort paying off; Bisons outnumber B-52 bombers.

By Claude Witze

Washington—Soviet Russia's air force, already larger by thousands than that of the United States, is fast overcoming our lead in quality—largely through increased research and development efforts—Congress was warned last week.

In the frankest assessment of Soviet capability given to the public by the U. S. Air Force, Chief of Staff Nathan F. Twining told the Senate Armed Services Committee:

- **Russia has more Bisons than this country has B-52s and can keep the advantage.**
- **USAF has more B-36s than Russia has Bears, their turboprop heavy bomber, but Russia could pass the U. S. in this category in the next two years.**
- **USAF has many more B-47s than Russia has Badgers, the comparable medium jet bomber.**
- **Russia has thousands more light jet bombers, the Beagle, than USAF has B-57s.**
- **Russia has thousands more new jet fighters than this country has.**
- **USAF has more all-weather fighters than Russia has Flashlights but they could close this gap in two or three years.**

On top of this, Gen. Twining declared, USAF does not have its present combat wings at top effectiveness. The reason for this is lack of operation and maintenance funds.

"I want to emphasize," he told the Senators, "that operation and maintenance money can be the difference between an effective and non-effective combat force. There is no point in spending billions of dollars for air weapons systems and bases if we are not going to have enough money to maintain and operate them properly—money to pay operating costs, money to maintain our bases, money to buy the fuels, spares and supplies we need to keep the Air Force operating."

Army Airlift Needed

Gen. Nathan F. Twining, USAF Chief of Staff, told the Senate Armed Services Committee last week that bigger planes must be provided to give the U. S. Army the mobility it needs. He said:

"As to Air Force capability to move Army forces, we can now lift an airborne division, without its heavy equipment. But to do this, we would have to divert aircraft from the Military Air Transport Service.

"And the Army would have to fight with light equipment, waiting for this shipment of heavier equipment. We do not have enough lift to do this job, and at the same time carry out the wartime priority task of moving Air Forces into striking positions.

"However, the future increases in airlift capacity will mean more mobility for the Army as well as the Air Force."

Bigger Budget Ahead

Gen. Twining did not turn his back on the proposed budget for Fiscal 1957. Like USAF Secretary Donald A. Quarles, he said he supported it, but his statement left no doubt that he considers the United States at a critical point in the arms race, handicapped by complacency and lack of money and research and development effort.

He said the proposed budget meets essential needs on a minimum basis and that a bigger budget will be necessary for Fiscal 1958.

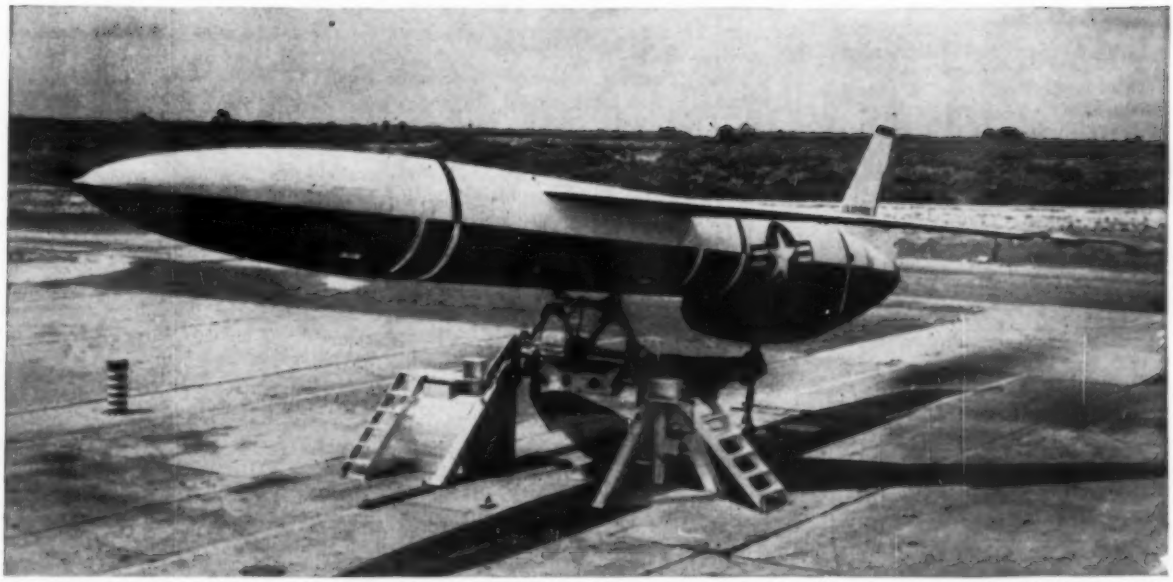
"It looks like the Communists could catch up," Gen. Twining said. "If they continue their rapid pace, it may be necessary for us to speed up."

On the subject of research and development, the General said the Russians are putting "more men and money into this battle of the laboratories than we are.

"This greater effort could also result in the Soviets obtaining better missiles sooner than we."

ICBM Prediction

He predicted that they could make good in their threat to have an inter-



NORTHROP SNARK, only long-range U. S. missile available in preproduction quantities, could become an operational delivery system with minimum effort and time. Flight tests have shown accuracy of Mk. 1 inertial guidance system incorporating star-tracking. Extra fuel can be carried in pylon-mounted wing tanks. Snark is powered by an Allison turbojet, is comparable in size to a light bomber.

Twining Warns Congress

GEN. NATHAN F. TWINING

continental ballistic missile in the near future.

Gen. Twining started his presentation with a frank admission that the Russians continue to outpace our estimates of their capability. He recalled a revised picture given to Congress last June, after the spring flyover demonstrations of Soviet airpower, and the step-up in aircraft production recommended at that time.

On the overall aircraft picture at this time, Gen. Twining said "they either have overtaken us in quantity, or can overtake us, in all categories of warplanes except that of the medium jet bomber."

However, he said, "it is their push for quality that is of even greater concern."

In this connection, he said the Bison and Badger jet bombers compare favorably with our B-52 and B-47, although USAF retains a "slight edge" in performance.

Soviet Improvements

He pointed out that our refueling capability and foreign bases add to USAF's effectiveness but "it would be imprudent to assume that the Soviets cannot conduct aerial refueling operations." The general said he is convinced that we are ahead of the Russians in this technique.

The Chief of Staff said the Russians are handicapped in the field of foreign bases and the directions from which they can launch attacks but they "are taking steps to correct this." The improvements include more bases, modernized and expanded in Eastern Europe and the Far East.

Also, he said, there are new airfields in the satellite areas, China and the Arctic.

He said the Russian development of Arctic bases "indicates a determined effort to further develop year-round capability to handle long-range aircraft all along this perimeter.

"From these Arctic bases alone, the Soviets could launch several hundred long-range bombers in a single attack."

The general estimates that the new Russian turboprop bomber, the Bear, has intercontinental range. This is a capability that the Reds did not have two years ago, and it comes as we are phasing out the B-36 and have not taken steps to provide a turboprop substitute.

Other major points made by Gen. Twining in his statement to the committee include:

- USAF's experience in long-range operations should help us to ready our organization more swiftly than Russia can prepare for war.
- Soviet air defenses are improving fast, particularly with their fast production of all-weather interceptors. This means the U. S. attacking force, in event of war, would meet more severe losses.
- The century-series fighters that USAF will get, such as the F-102 interceptor, F-101 and F-104, will place the U. S. in a much better defensive position.
- USAF's transport capability will get a boost in Fiscal 1957 and even further outstrip the Russians in this category.

Nuclear Weapons

On the subject of nuclear weapons, Gen. Twining declared we have our biggest advantage but again "the Soviets are making impressive efforts."

The general then gave this comparison:

"Our own defenses and Soviet attack capabilities are both increasing. By the time the Soviets have a bomber force large enough and effective enough to wage a global war, our defenses will be formidable.

Fighters vs. Bombers

"Our present F-100 would be effective against the Soviet Bison, compara-

USAF Budget Increase?

New revelations by USAF Chief of Staff Gen. Nathan F. Twining and USAF Secretary Donald A. Quarles on Russian and U.S. airpower brought these comments from Senate Armed Services Committee members:

Sen. Richard B. Russell (D.-Ga.), chairman: "I am far from reassured by the conclusions they have reached on the adequacy of our program. I greatly fear (the Administration is) taking long chances with the security of the country." Sen. Russell said he will fight for a $1.5 billion increase in USAF's Fiscal 1957 $16.5 billion budget request.

Sen. Stuart Symington (D.-Mo.): "It was never more clear . . . that in 1956 this Administration is deliberately risking our national survival in order to balance the federal budget."

Sen. Herman Welker (R.-Idaho): "I am very distressed as a result of the hearing. It looks to me as if we are getting weaker instead of stronger in relation to Russian strength." He said he is sure taxpayers "will back us to the hilt" in seeking more USAF funds because "the taxpayer would rather not be the richest man in the graveyard."

ble to our B-52, but the Soviet Bison is available now only in limited numbers. By the time the Soviets get a sizable force of Bisons we will have the F-101, F-102 and F-104 in quantity. . .

"Comparing our attack strength with Soviet defensive strength reduces itself to the question: Can our bombers get through?

"The Soviets have thousands more jet fighters than we, but they also have an enormous area to defend. In my judgment the Strategic Air Command continues to have the ability to get through."

'Remarkable Strides'

"I cannot deny the Soviets are narrowing our margin of superiority. They have long since passed us in quantity and they are making remarkable strides in quality."

Reviewing U.S. missile developments, Gen. Twining called the joint Army-Navy project to build an intermediate-range ballistic missile (IRBM) a backstop to a USAF project already underway.

As for the intercontinental ballistic missile (ICBM), he said USAF is on schedule "but no one can guarantee at this time that our future schedules on these missiles will be met." On this subject, other Congressional committees have heard Trevor Gardner, former Assistant Secretary of the Air Force for Research and Development give the opinion that the ICBM program is not getting the necessary priority.

Gen. Twining said the proposed Fiscal 1957 budget would do these things for USAF despite its austerity:

- **Enlarge SAC's capability. Four heavy reconnaissance wings will be converted to heavy bomb wings, eventually with B-52s.**
- **TAC will grow from 34 to 41 wings and get improved capability.**
- **TAC's flexibility and range will be increased with aerial refueling.**
- **Air Defense Command and the warning system on which it depends will continue to grow.**

Too Few Technicians

For maintenance of this Air Force, the Chief of Staff said, "We are still not getting enough top-notch maintenance and electronic technicians." This clearly was a reference to TAC's problem of inability to keep its fighter wings combat ready, including those equipped with the F-100.

He said that the entire Air Force feels the effect of this condition and warned that "during this year, achieving planned readiness may not be possible, handicapped as we are by limited operation and maintenance funds. We face a similar difficulty in Fiscal 1956 unless we get the funds requested."

The General included a strong appeal for more room from which to operate. He said USAF's striking force is jammed on too few bases, and disclosed:

"Our plan to reduce this vulnerability, and to decrease the reaction time of our striking force is to disperse our heavy bomber units one squadron, or one-third of a wing—to a base. We also plan to cut down the medium jet B-47s to one wing per base. We now have two wings on many bases.

"Our present deficiency of facilities not only endangers our striking force, it slows our buildup. It cuts our combat capability. It reduces flying safety, and it cuts sharply into our efforts to keep our skilled men in the service.

"Let me warn you that, if war comes, our success in the decisive phase will depend on the force we have in being the day the war starts."

Strike Shuts Down Four Republic Plants

New York—Both sides cried "foul" last week as a strike for higher wages by Republic Aviation Corp. production workers virtually halted output of F-84F Thunderstreaks, RF-84F Thunderflashes, sub-assemblies and guided-missile and electronic components.

In the early stages, there were a number of injuries in clashes between pickets on the one hand and police and non-striking employes (mainly supervisory, plant protective and clerical personnel) on the other. By midweek, about 75 pickets had been arrested for violence and disorderly conduct at the main plant in East Farmingdale.

Neither side last week seemed ready to alter its final offer made before the strike broke. However, the company was putting the finishing touches on its plea for a court injunction to bar mass picketing.

The strike began at midnight Feb. 18 after three weeks of negotiation between the company and Lodge 1987 of the International Association of Machinists ended in a deadlock. The company had offered a 5-cent-an-hour increase; the union had demanded a 19-cent package. The union's demand was scaled down from an opening bid for 38 cents; Republic stood pat on its original offer, "dictated by economic necessity and to keep from being priced out of the market." A company spokesman said Republic was paying the highest scale in the industry, $2.23 an hour. The union estimated the average wage at Republic as $1.97.

The negotiations were started on the basis of a wage reopening date in the Republic-IAM contract. Expiration date of the contract is Feb. 18, 1958.

Although both sides were standing fast, the company expressed its willingness to resume negotiations on the basis of the 5-cent offer and an IAM official said the union was ready to "negotiate, conciliate, mediate or arbitrate."

The violence, which was greatest last Monday when 58 were arrested (including IAM lodge president Justin Ostro) appeared to be tapering off. The troubles were blamed by Republic on mass picketing, which resulted in the roughing up of employes attempting to enter the plant gates.

The union claimed that the Suffolk County police, working with the company, were provoking and creating incidents and said that pickets had been instructed to keep their hands in their pockets to prevent violence.

Of Republic's approximately 12,000 production workers, about 5,900 voted on the strike issue, with 61% voting to turn down the company offer and 31% voting to accept it. Because of this, Republic management claims the strike was called by a minority of about 4,700 workers and that the stay-aways represented a protest vote against union leadership. The IAM says not so; approximately 1,500-2,000 who came to vote went home because of the long lines waiting to cast their individual secret ballots and because of the inclement weather.

Quarles Reports to Congress:

Only Two USAF Missiles in Production

Washington—The Air Force has only two guided missiles in production with a third in "kind of a preproduction phase," USAF Secretary Donald Quarles testified before the House Appropriations Military Subcommittee. USAF production missiles are the Hughes Falcon, an air-to-air missile that is being fitted to the Northrop F-89H, Convair F-102A and the McDonnell F-101A; and the Martin Matador TM-61 training missile. The Northrop Snark, a 5,000 miles range subsonic cruise type missile was described by Quarles as in the preproduction phase.

Quarles' testimony, delivered just after Trevor Gardner resigned as his assistant secretary for research and development, was released by the House committee after being edited by the Department of Defense for military security. Quarles declined to answer for the public record whether he has any factual intelligence that the Russians have test fired ballistic missiles hundreds of miles farther than anything tested by the United States. Quarles answered this question from Subcommittee Chairman George Mahon (D.-Tex.) off the record. The Russian missile test firings have been recorded by USAF technical detection systems for more than four months and have been accepted as a fact at the highest Pentagon policy level (AW Feb. 20, p. 26).

Alternative Approach

Quarles confirmed that the Air Force had accelerated its intercontinental ballistic missile program about two years ago as a result of technical breakthroughs that permitted less accuracy and smaller warheads for this type of weapon.

"We re-oriented the contractor structure leaving the company that had been our main contractor (Convair) still in the picture. They are now our airframe contractor for one version of the ICBM," Quarles said. "But we did bring in as direct contractors to the Air Force companies in the propulsion field, companies in the guidance field and companies in the nose-cone re-entry field, all three of which involve very serious and to some degree separate problems from the airframe problem.

Defense's Viewpoint

"In addition at that time, under the advice of a very high level and competent scientific advisory committee, we decided we should have an alternative approach to the airframe design of this weapon. In line with that decision a contract was subsequently given to follow an alternative approach to the design and alternative contractors were brought in on the other three important phases—propulsion, guidance and nose cone.

"We now have in the long-range program prime contractors in these four areas of each of two different approaches to this problem which means in effect we have eight or so different prime contractors moving ahead in the ICBM program. They have all been instructed that the program carries the highest Department of Defense priority and support and that the Department of the Air Force will do everything possible to expedite it.

Quarles confirmed Congressional criticism that the standard work week on the ICBM program had been an eight hour day, five day week but said that it was being increased to a 45 hour work week. He said the engineering personnel on these programs were working a substantial amount of overtime on creative engineering, detailed engineering and various testing programs.

Short-Range Missile

"Actually we are pushing all contractors as hard as we can to accomplish their programs at the earliest possible time," he said. "For this purpose they are authorized unlimited overtime. In addition where we are in the fabrication and testing stage for developmental items such as propulsion systems, three-shift effort is being applied where required. . . . We plan to use multiple shifts and seven day work weeks where required when we get into the fabrication and production phases of this program."

"We have recognized all along that there might well be a requirement for a missile of shorter range than the ICBM. We have also recognized that many of the things we were doing for the longer range would be applicable either directly or through modification—but not requiring new science—to shorter range.

"So it was our feeling that in view of what we considered to be the top priority for the long-range missile, and in view of the potentialities of the science for the shorter range missile falling out of this other work, the Air Force has only recently actually embarked, project-wise, on the shorter range, so-called intermediate-range missile."

Defense 'Outclassed'

The program for an anti-ballistic missile defense has just recently moved from the study phase into active projects, Quarles told the committee.

"We do have some projects going forward on it and it does not appear to be a hopeless proposition to combine an atomic warhead with an interceptor type missile to destroy an oncoming ballistic missile with an atomic warhead. It is not a hopeless proposition but a very difficult one. . . .

"Our interceptor missiles today are a valid defense against missiles of the Matador and Regulus types. By the time we get air breathing missiles that can go to very high altitudes and very high speeds it is my belief we will have interceptor type missiles in the same region.

"So I think the only area in which direct defense seems to be completely outclassed by offense is in the ballistic field."

'Misleading, Damaging'

In evaluating the role of missiles in future USAF plans Quarles made it clear that he expects the main burden of Air Force missions to be carried by manned aircraft for the next five years and possibly for the next 10 years.

"I would think that in a global war five years from now the guided missile would not be a decisive factor—that is the long-range missiles. I think that five years from now guided missiles will be playing an important supplementary role. But I would not think that long-range bomber types of guided missiles, either air breathing type or ballistic types, would play as important a part

ICBM Contractors

These are the contractors referred to by USAF Secretary Donald Quarles in explaining expansion of the intercontinental ballistic missile program to Congress:

- **Airframe—Convair Division of General Dynamics Corp. and the Martin Co.**
- **Nose-cone—General Electric Co. and Advanced Development Division of Avco.**
- **Propulsion—North American Aviation Inc., and Aerojet Division of General Tire and Rubber Corp.**
- **Guidance system—General Electric Co. and Arma Division of American Bosch Arma Corp.**

five years from now as will our manned bombers. . .

"I regard as highly misleading and damaging to our whole position here the line of publicity that says 'this is an ultimate weapon, that we have no defense against it;' that the first fellow that gets it is going to be on top and the rest might as well throw up their hands. This is a line of talk I deplore.

"I think it is unsound, and particularly unwise as a United States line, faced as we are with the possibility that somebody will say 'Why don't you throw up your hands?'

"Let me explain why I think it is unsound: the Russians today have plenty of medium-range bombers that have all the bases in Europe that we are talking about within their range and that have the capability of delivering atom bombs against these bases with more precision than we expect them to have with a ballistic missile for some time to come.

"Therefore they know and we know that the mere addition to their arsenal of a 1,500 mile missile to do the same job would not materially affect the balance of power between the two blocs. They know and we know that until they have an effective means of knocking out our retaliatory power before it can get off the ground, they do not have a sound basis for starting a war. And they know that the addition of even an intercontinental missile of any accuracy that they are apt to have within the next decade will be only a marginal advantage to them over their bombers.

"Moreover we know that we will have B-52 bombers that can do a much better job for sometime to come than anybody can hope to do with missiles of any kinds. We will also have air-breathing guided missiles that will have range and precision and load carrying capacity at least equal to the ballistic missile if not better, and some of them will be so difficult to intercept that I would expect their ability to get through to be comparable though not equal to the ballistic missile.

"The point I am making is that we have got this thing completely out of perspective. We have scared our people to death about something that to be sure is a horrifying weapon. But it does not kill you any deader than a bomber does with an atomic bomb. Nobody is going to start a war because they have this kind of weapon unless they can see a way out that will avoid destruction of themselves. The addition of this weapon to their arsenal, whether or not we have it, will not avoid destruction to themselves.

". . . We are recognizing it (the ICBM) as a very potent addition to our arsenal but we are not recognizing it as a weapon that will revolutionize warfare, whichever side gets it first."

Gardner Says Budget Guarantees Nation 'Second Best Air Force'

Washington—"The Fiscal 1957 budget will guarantee the United States the second best Air Force in the world."

This statement on a national television program by Trevor Gardner, who recently resigned as Assistant Secretary of the Air Force for Research and Development, climaxed a week of testimony before Congressional committees that touched off the most bitter debate over military airpower the Capitol has seen since the Congressional investigation of the B-36 program in 1949.

Among the other statements made by Gardner during last week:

- **Russia is ahead of the United States in the ballistic missile development race.**
- **Boeing B-52 production program should be tripled to produce about 45 of the long-range jet bombers a month.**
- **Russia is overtaking the U. S. in aircraft development at an alarming rate.**
- **USAF needs a total budget of about $20 billion including an additional $500 million to match or surpass the Russian challenge in aerial weapon systems development.**
- **Missile program needs a congressionally authorized czar to operate a "crash" program aimed at producing maximum results in minimum time.**
- **USAF Fiscal 1957 budget as submitted to Congress is about $3.5 billion less than the Air Force specified as necessary to continue its expansion and maintain combat-ready forces.**
- **Responsibility for the lack of sufficient funds in the Fiscal 1957 budget rests squarely on President Eisenhower, Defense Secretary Charles E. Wilson, USAF Secretary Donald A. Quarles and the Bureau of Budget, all of whom, according to Gardner, failed to support the USAF program.**

Gardner gave the House Appropriations Committee in executive session the first complete picture of the budget slashing process from which USAF emerged with a $16.5 billion Fiscal 1957 request to Congress. Original USAF budget designed to carry out authorized expansion to 137 combat-ready wings, push research and development at a pace to surpass the Russians and modernize the USAF front line aircraft inventory with the new weapons was computed at $20 billion. USAF regarded this figure politically impossible because of the Defense Department budget ceiling imposed by the Bureau of the Budget in its effort to present a balanced national budget for Fiscal 1957.

Consequently, according to Gardner, USAF pared its budget request to $18.8 billion for submission to the Defense Department. Secretary Wilson then pared this by another $2.3 billion to the $16.3 billion sent to Congress.

Congressmen reported Gardner told the committee that the Defense cuts knocked out about $1 billion for aircraft procurement; $600 million for other procurement including radar and avionics for the SAGE air defense environmental system; $400 million for operations and maintenance and $300 million for base construction and research and development.

USAF has been operating under a Defense Department-imposed budget ceiling for its research and development effort for the past three years, Gardner said. He pointed out that this budget ceiling was imposed despite tremendous progress being made through a series of scientific breakthroughs that offered opportunity to surpass the Russian pace in aerial weapons development.

He said that ample funds now were available for development of the intercontinental ballistic missile (ICBM) and the intermediate-range ballistic missile (IRBM) but that these funds were available only because they had been diverted from the aeronautical research program on manned aircraft.

Gardner said that the principal problem in pushing aeronautical research and development was getting sufficient money to exploit scientific progress.

"Technological breakthroughs are occuring at a rate that appears more rapid than the ability of our decision making machinery to adjust to them," he said.

He promised to provide the Joint Congressional Committee on Atomic Energy with a specific set of recommendations for speeding the development program in guided missiles.

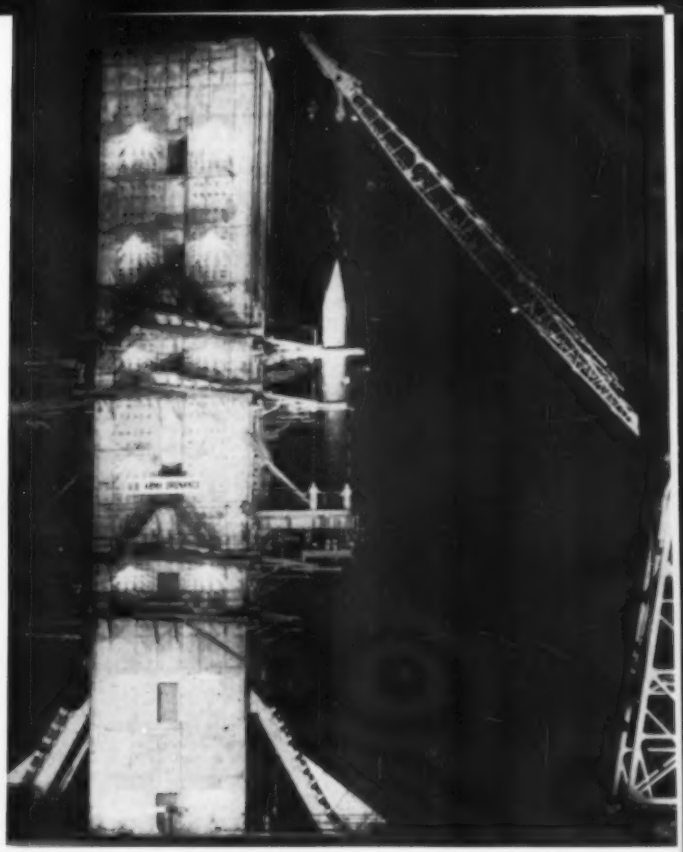
"We have three services competing in the ballistic missile field," he said. "We have just one test range and they compete for test time. As the three services move into this field more heavily and with no restrictions on funds there needs to be some central authority to coordinate the activities of the three services and direct the kind of progress and resolve the kind of problems that are encountered."

Gardner said that he had talked to President Eisenhower on the missile program under "controlled" conditions that made it impossible for him to present a complete and accurate picture of current progress and problems.

"I didn't consider the short time I had (with the President) permitted me to convey the true picture to him," he said.

Army's Redstone

STATIC FIRING of Army's Redstone missile (right) follows its installation in this gigantic test stand at the Redstone Arsenal in Huntsville, Ala. The symmetry of the stand indicates that two static runs can be made simultaneously. Fueling and checkout of Redstone (below) is carried out in this gantry before firing. Missile tests have been made at Air Force Missile Test Center, Patrick AFB, Fla. by Army Ordnance teams. First firings of the 60-ft. missile were made in May, 1953.



REDSTONE heads upward in this extensively retouched picture of the surface-to-surface weapon. Developed by a group of ex-German scientists from Peenemuende under technical direction of Army Ordnance, Redstone has a range comparable to the old V-2, operational in Sept. 1944. Redstone development program could lead to two-stage missile with 1,500 mi. range.

Profit Hearing May Mean New Legislation

By Katherine Johnsen

Washington—Congressional hearings on the profits of airframe manufacturers are expected to lead to new procurement legislation.

The first companies to testify before the House Armed Services Investigating Subcommittee, headed by Rep. Edward Hebert (D.-La.), were North American Aviation, Inc., the Martin Co. and Boeing Airplane Co.

Developments of major consequence to the industry that may be watched for are:

- **Comparison** of the procurement treatment of the different firms. This would include the cost allowed for top management salaries and other overhead, based on business volume. It is understood that some firms with twice the business have management costs approximately half those of other airframe firms.
- **Comparison** of Air Force and Navy records with industry figures. It is understood that some of these differ. The subcommittee's plan is to take testimony of the 15 airframe companies first, and then hear representatives of the services.
- **Replacement** of the Renegotiation Law, with its vague criteria for adjudging excessive profits.

WILLIAM M. ALLEN (left), Boeing Airplane Co. president, and Boeing controller Clyde Skeen confer during House Armed Services Investigating Committee hearing on profits.

Renegotiation

Dissatisfaction with the secrecy, the arbitrariness, and the slowness of operation of the Renegotiation Board is widespread in Congress. The Senate Small Business Committee, reflecting the position of small industries is expected to begin hearings soon to launch its drive against renewal of the measure, due to expire Dec. 31.

It is recognized, however, that, particularly in an election year, Congressmen are not likely to discard the renegotiation control on profits without some kind of replacement to take care of predominantly Government contractors operating under negotiated contracts.

One outcome of the Hebert hearings may be legislation setting uniform standards on negotiated Government contracts, spelling out the amount of profit allowance on the basis of sales volume, on the basis of private invested capital, or on the weighted average of both of these.

North American, Boeing

There is also the prospect that the salary, advertising, association contribution allowances, and other overhead of firms doing a major percentage of business with the Government would be limited.

At the initial sessions, J. L. Atwood, president of North American, and William Allen, president of Boeing, emphasized the low profits of their companies, based on sales volume. George M. Bunker answered questions but did not make a special presentation for Martin, which he heads.

North American made 3.4% profits on sales in 1954, compared with the manufacturing average of 5.9%. By comparison, the profit on sales of General Motors Corp. was 8.3%; du Pont de Nemours Co., 20.4%; Standard Oil of New Jersey, 10.3%.

Boeing's profits averaged 2.4% of sales during 1952 through 1954, compared to 10% for the chemical industry and 6.6% for the automotive industry.

Clyde Skeen, controller of Boeing

North American Aviation

GOVERNMENT OWNED PROPERTY: $95,413,948*
PRIVATE PROPERTY: $18,038,148

	Total Sales	Government Sales	Profits After Taxes	Net Worth	Remuneration To Officials Making Over $20,000
1952....	$315,270,855	97%	$7,820,886	$57,440,750	$506,080
1953....	634,688,156	99.02%	12,773,361	.....	728,313
1954....	645,821,018	99.56%	22,179,736	.....	894,162
1955....	816,676,329	99.66%	32,349,176	94,686,484	993,250

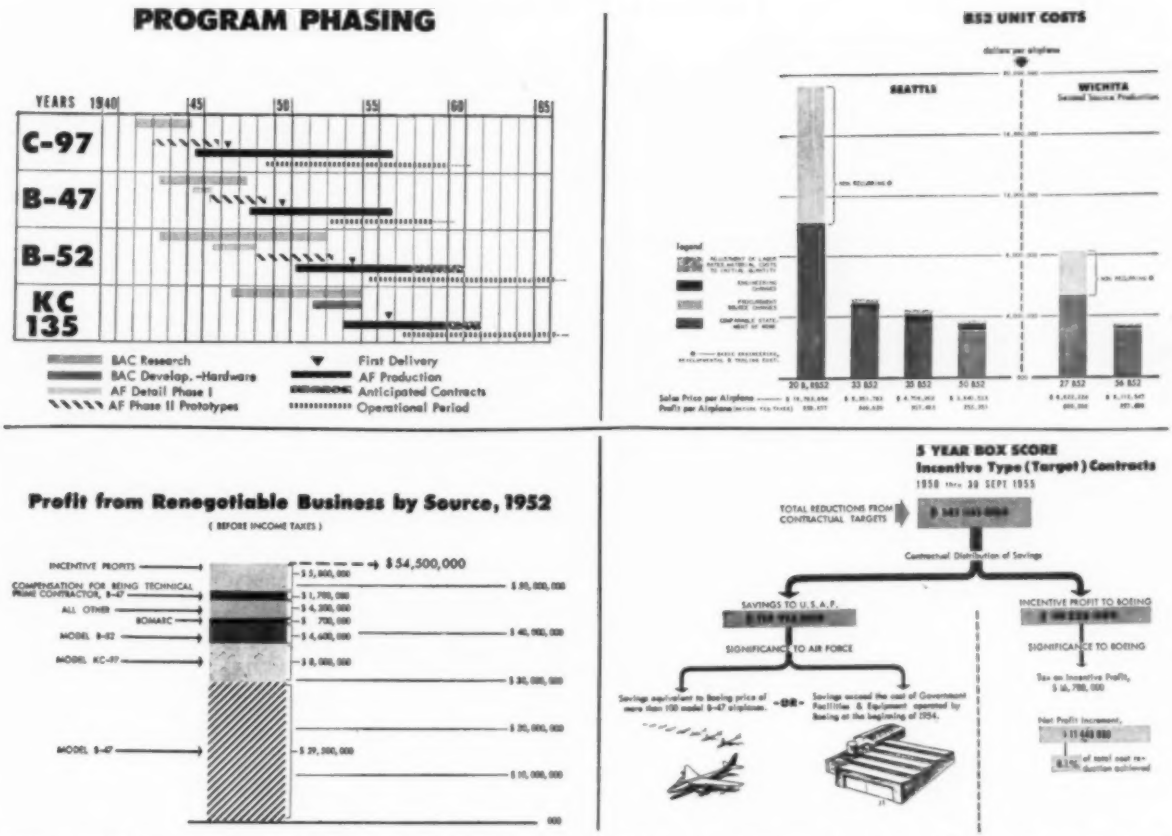
* This does not include missile plant at Downey, Calif., on which determination has not yet been made.

The Martin Co.

GOVERNMENT OWNED PROPERTY: $41,470,786
PRIVATE PROPERTY: $11,135,631

	Total Sales	Government Sales	Profits After Taxes	Net Worth	Remuneration To Officials Making Over $20,000
1952....	$143,999,382	69.5%	$5,808,312*	$11,051,264	$286,992
1953....	209,006,653	98.3%	15,094,756*	.....	401,075
1954....	270,789,973	99.6%	20,052,315	.....	494,416
1955....	126,999,051 (5 months)	99.7%	.....	52,144,710	179,164 (5 months)

* Because of prior year losses Martin paid no income taxes in 1952 and 1953 and only $1 million in 1954.



FOUR TABLES above were prepared by Boeing for committee hearings. Table at top left shows time lapse between initial concept and delivery of four aircraft; top right, units cost of B-52. Bottom tables show Boeing's renegotiable business and incentive-type contracts.

told the subcommittee that earnings on sales "is the most meaningful comparison since it gives recognition to actual work accomplished and effort expended."

Developments during the questioning included:

• **Rep. Hebert** declared that North American is a "Government subsidiary," using Government property and Government business to pay private profits. He made the statement when Atwood pointed out that the company's $750,000 advertising budget for this year would be paid out of profits and not charged as a cost against Government contracts. With 99.66% of North American's business coming from the Government, Hebert commented, "the money all comes from the same source. It's just a case of Tweedle-dee and Tweedle-dum."

• **Rep. George Miller (D.-Calif.)** argued that there is no more reason for North American to spend money for advertising than for the National Academy of Sciences or a naval depot.

Miller suggested that the Government handle aeronautical projects through the developmental stage, and then "farm out the construction" to a competitive industry. Atwood objected that "the bureaucratic type" organization would not be effective and that private industry, with the profit motive, is "by far the best means of designing and developing aircraft." Atwood concurred that National Advisory Committee for Aeronautics had been a success, but pointed out that it is limited to theoretical projects.

• **Rep. Leon Gavin (R.-Pa.)** protested the no-rent policy on the use of Government facilities by airframe firms, claiming that it put competitors at a disadvantage. Atwood pointed out that rent charged would simply become costs on Government contracts.

The three-step procedure of the subcommittee is to (1) permit the witness company to make a presentation, (2) develop details on individual contracts and the over-all company financial position, through questioning by Subcommittee Counsel John Courtney, and (3) allow questioning by committee members.

Plane Breakdown

Details developed on North American and Martin types were:

• **North American.** The unit price of the F-86D was $535,000, with $38,505 allowed as profit. On subsequent models, the prices were: F-86E and F-86F, $129,427, with $8,511 profit; F-86H, $460,396, with $37,153 profit.

The unit prices and profit allowance on other types were: F-100A, $663,354, with profit of $52,422; AJ-1 Savage, $1,321,972, with loss of $33,570; AJ-2P, $993,504, with profit of $103,769; AJ-2, $734,545, with profit of $65,472; AJ-2P follow-on, $1,481,843, with $147,942 profit; FJ-2 Fury, $511,304, with $46,767 profit; FJ-3, $252,667, with $28,168 profit; T-28A, $88,322, with $4,985 profit; T-28B, $88,672, with $7,474 profit.

• **Martin.** The unit cost on the first eight B-57s, including plant tooling-up costs, was $8,596,518, it was $1,213,529 on the follow-on order for 67 planes. The profit allowance per unit was $137,480. The B-57B unit cost was $806,590, with a profit allowance of $64,458.

It was developed that North American's stock mounted from $25 a share in 1952 to approximately $80 a share today, during the period of over 99% Government business.

Atwood reported that North Ameri-

can has spent $40 million for capital additions over the past five years and will spend $26.6 million this year.

"Merely being in the aircraft manufacturing business does not guarantee that you will be successful, either technically or financially, regardless of the award of contracts by the Air Force, the Navy or any other Government procurement agency," Atwood said.

"You have to be capable of building a large, efficient and dedicated organization to achieve what has been accomplished by North American and others in the industry. Yet, for all of this, out of every dollar paid to North American for our efforts since the close of World War II, only a little more than three cents is compensation for work done by way of profit." He added:

"If we continue to regard our policies and procedures relating to the development and maintenance of our military strength as something temporary in duration, we are treading a road which can lead to very serious consequences.

"The industrial capabilities of our country must at all times be able to maintain a defense establishment that will guarantee the preservation of peace or the successful prosecution of war. The defense industry has become a vital part of our industrial strength."

Boeing's controller Clyde Skeen protested Renegotiation Board decision requiring a $10 million refund as excessive profits on the company's 1952 business, and declared that the "controlling factor" in the decision was net worth. Boeing's profits were 92.5% of net worth before taxes and 27.7% of net worth after taxes.

Skeen maintained that net worth "is not a reliable index of the reasonableness of a contractor's profits and therefore it should have no place in the renogotiation process."

He pointed out that Boeing, since 1946, has already expended $42.3 million on plant and equipment, and plans to expand an additional $73.5 million through 1958.

At the Pentagon is was learned that the new regulation (AFR 80-28) was enforced for the first time early this month at an inspection of the Lockheed F-104. Fewer than 40 personnel took part and unauthorized persons were barred.

"Boeing believes its earnings in 1952 were reasonable under any and all concepts of renegotiation," Skeen said. "When a company has made a substantial contribution to the defense effort . . . and its profits are within the contractually established profit framework, a determination of excessive profits is patently unjustfied.

"If allowed to stand, such a determination will go far toward removing the element of incentive which is so important to progress in research, development and production efficiency."

Industry Complaints Bring Limits On Visits by Inspection Boards

Washington—U.S. Air Force has taken two steps to eliminate growing aircraft industry dissatisfaction with the burden of plant visits from mockup and contract technical compliance boards:

• **Size of the boards** has been increased slightly to insure adequate representation by interested commands.

• **USAF has issued** a firm rule against unauthorized "visitors" going along on board visits. No board will be allowed to exceed a maximum of about 50 men.

Action followed industry complaints that the numbers of plant visitors for a board inspection has been increasing to the point where as many as 200 USAF officers and civilians would take part in the study of an important new weapon.

The new rules provide that on mockup boards for other than Army aircraft, one member each is authorized for the Director of Requirements and Director of Research and Development of the office of the Deputy Chief of Staff for Development; for DCS, Materiel and DCS, Operations; the Air Materiel Command; the Air Research and Development Command; the Air Training Command, except when it is a using command. Each member has one vote.

There will be one non-voting member from the office of the Inspector General. Major air commands or using services scheduled to receive a weapon will be allowed at least nine voting members.

When the Army is scheduled to use the aircraft, it will be allowed to have one voting member.

Contract technical compliance inspection boards for other than Army aircraft will consist of three voting members, one each from AMC, ARDC and the office of the Director of Requirements, DCS for Development.

When a board is convened for mockup or technical compliance studies of an Army aircraft there will be six voting members representing the Director of Requirements, DCS Development; AMC, ARDC, the Army's General Staff, Chief of Transportation and Continental Army Command. There will be one non-voting member from the Tactical Air Command.

In addition to the board members, the new regulation authorizes advisers. Basic to the mockup board are three from USAF headquarters, eight from AMC, 12 from ARDC and five from each using major command or service.

At the Pentagon it was learned that the new regulation (AFR 80-28) was enforced for the first time early this month at an inspection of the Lockheed F-104. Fewer than 40 personnel took part and unauthorized persons were barred.

New Missile Split

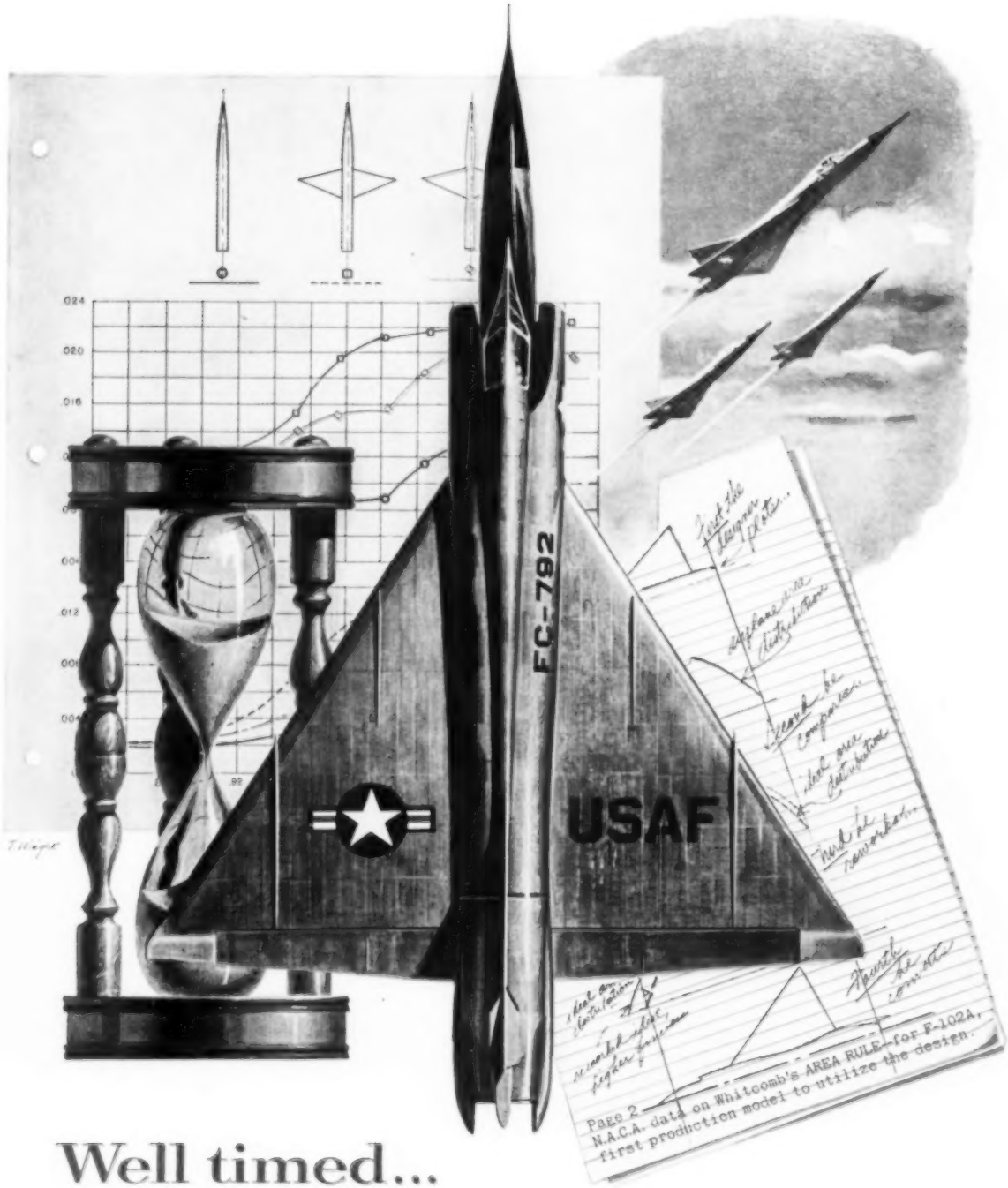
Washington—Chrysler Corporation's assignment for weapon system responsibility for the joint Army-Navy intermediate-range (1500-miles) ballistic missile puts the firm squarely in the middle of a growing split between the two services over this project.

Chrysler, which has been the prime contractor on the Army Redstone missile, is expected to develop an intermediate-range missile suitable for both Army use on land and Navy use aboard ships at sea. The present joint IRBM program represents a compromise between the divergent requirements for land and sea operations.

In the meantime the Navy Bureau of Ordnance is pushing hard for development of a solid-fuel IRBM with a relatively squatty configuration because of shipboard logistics and guidance problems. Army's Redstone Arsenal group is pushing for a liquid-fuel rocket embodying a long, thin design because logistics and guidance problems involved in terrestial launchings are less acute than in launchings from a relatively short and moving platform at sea.

Pentagon feeling is that the IRBM program—which now includes the USAF sponsored Douglas Aircraft project and a British program in addition to the joint Army-Navy project—will soon expand to four active projects, with the Army and Navy going their separate ways. The current compromise IRBM is expected to evaporate, with Chrysler taking over the Army-Redstone concept of a long, thin liquid-fuel rocket.

One of the biggest bottlenecks in this expanding IRBM program is powerplants, where North American Aviation Inc. and Aerojet division of General Tire and Rubber Co. are the sole sources of the type of liquid-fuel rocket engines now being designed into the three IRBM projects and the two USAF-sponsored intercontinental ballistic missile projects. Rolls-Royce is developing a North American type rocket engine for the British IRBM program under license from the California firm.



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Research and development cut the time between *needing* and *having* Convair's supersonic F-102A all-weather interceptor. Application of the AREA RULE gave the F-102A an hour-glass shape, enabling it to attain even higher performance into the supersonic speed range!

A result of extensive design, testing and re-designing, the delta-wing F-102A is now being produced in quantity for the U.S.A.F. Air Defense Command – evidence again of Convair's *engineering to the Nth power!*

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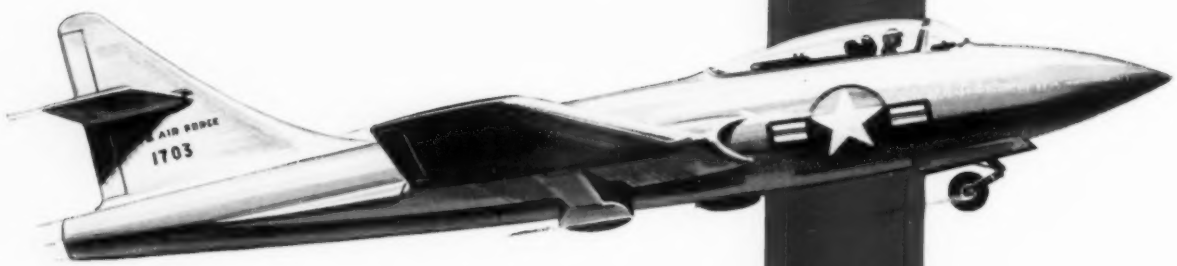

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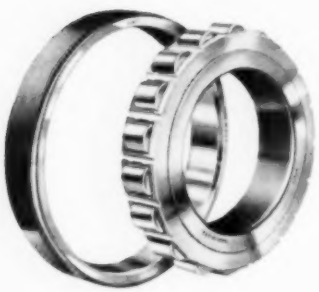

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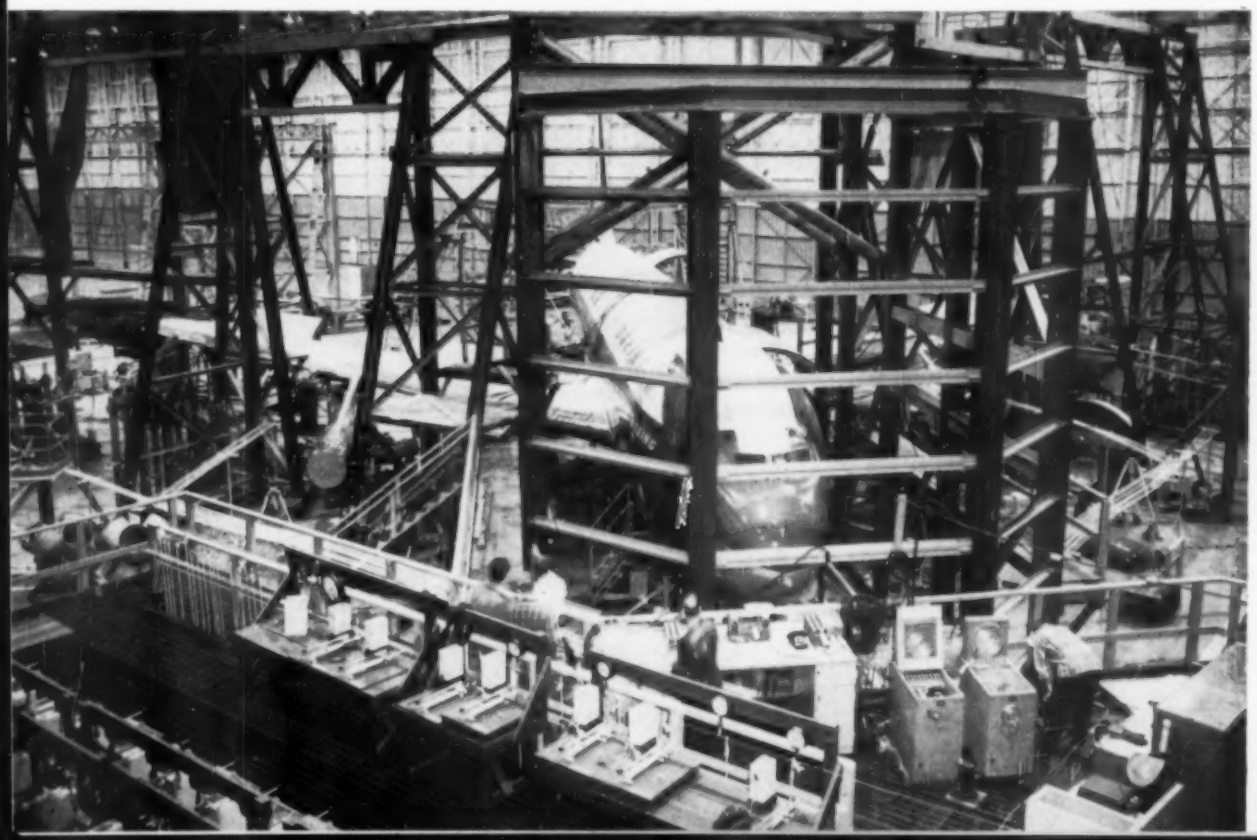
BOEING 707 in structural test facility (above and below) awaits instrument calibration.

Boeing 707 Enters Eighth Test Phase

Boeing's 707 jet transport prototype continues to accumulate flight test hours at a rapid rate. Since the 707's first flight July 15, 1954, the plane, in seven major flight test periods, has made more than 280 trips aloft totaling more than 360 flight hours to test systems, components and performance capabilities in actual flight.

The eighth major period, just underway, embraces flight load survey tests. The pictures on this and the following page illustrate Boeing's preparations for this flight phase, which is designed to check the stresses and strains imposed on the complete airplane structure under all flight conditions. More than 72 strain gages were installed throughout the wing area to record stresses and strains, and extensive static tests were made to calibrate the gages with recording instruments for correlation with the readings that will be obtained in actual flight tests.

The plane will carry more than two tons of recording instrumentation and associated equipment during this phase. This includes telemetering equipment; oscillographs which will gather information from instrumentation on the aerodynamic surfaces, control column, landing gear and accelerometers mounted in the wing tips and vertical fin; photo-



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Four of these Torquers with plain head are covered in Specification MIL-H-4034A (U.S.A.F.), Amendment 2, dated Aug. 20, 1954 – No. 6061F (Size 1–5 to 150 in.-lbs., ¼" Dr.), No. 6065F (Size 2 – 100 to 750 in.-lbs., ⅜" Dr.), No. 6069F (Size 3 – 700 to 1600 in.-lbs., ½" Dr.), and No. 6071F (Size 4 – 1200 to 4800 in.-lbs., ¾" Dr.).

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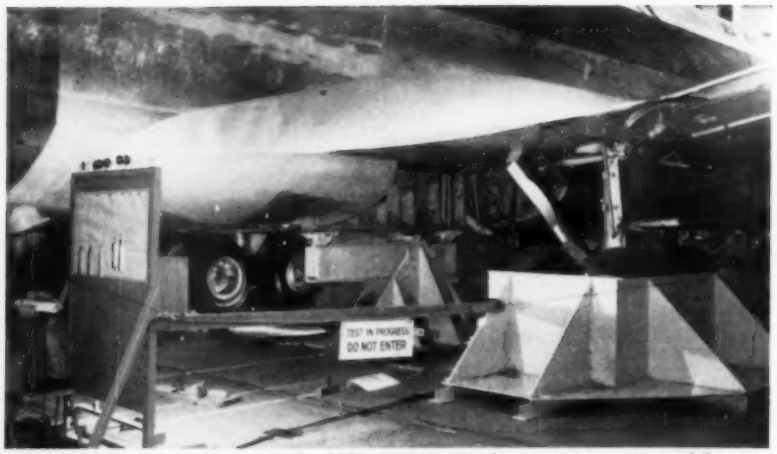
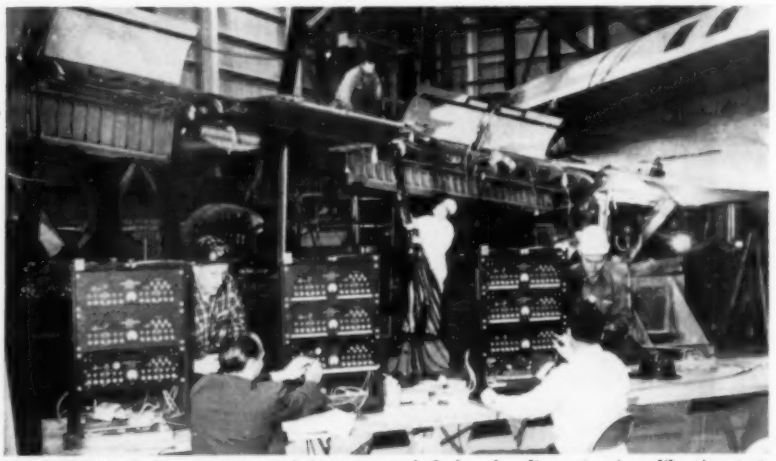


STRUCTURAL test engineer checks 707's position in the rig prior to test while . . .



. . . **INSTRUMENT** engineers set balance controls before bending wing in calibration test.

recorder panel to film cockpit instrument readings; temperature recorder to take data on engine, fuel, oil, hydraulic fluid and outside air temperatures; tape recorder to measure structural vibrations, and a graphic recorder tide into the oscillographs for an engineering observer.

The plane is equipped for operating 150 data recording channels, with an additional 100 available if needed.

In the preparatory static load phase, the 707 was suspended in a flight attitude in the structural test rig (the same as used in B-52 Stratofortress static tests) by a single-point mount attached to the plane's keel beam. This provided unrestrained lateral and longitudinal movement, as though in actual flight. The landing gear was down and clearing the floor by a few inches.

Positive loads on the wing were limited to about one-third design load. In the flight tests, the airplane will be tested to 80% of design load.

A number of modifications have been made in the 707 as a result of experience to date and information gathered in earlier flight tests. Top photo (above) shows redesigned solid side-load link on the main landing gear. The original gear failed during taxi tests in 1954 (AW May 31, 1954, p. 13). For the new flight phase, slight modifications have been made in the flaps, and the outboard integral wing reserve fuel tanks will be filled, bringing the craft's gross weight to nearly 200,000 lb.

An autopilot and glide slope antenna are also being installed for test purposes, and cabin acoustical material is being changed around as part of continuing noise level surveys in the plane.

Other changes include installation of an autopilot and a glide slope antenna, as well.

Navy Orders More Lockheed WV-2s

Burbank—Lockheed Aircraft Corp. last week announced receipt of a $60-million U. S. Navy order for WV-2 early warning radar planes.

While exact quantities were not disclosed, Lockheed said the new order will extend production of the aircraft through December 1957.

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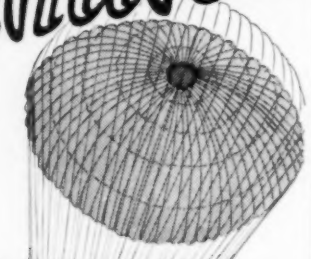

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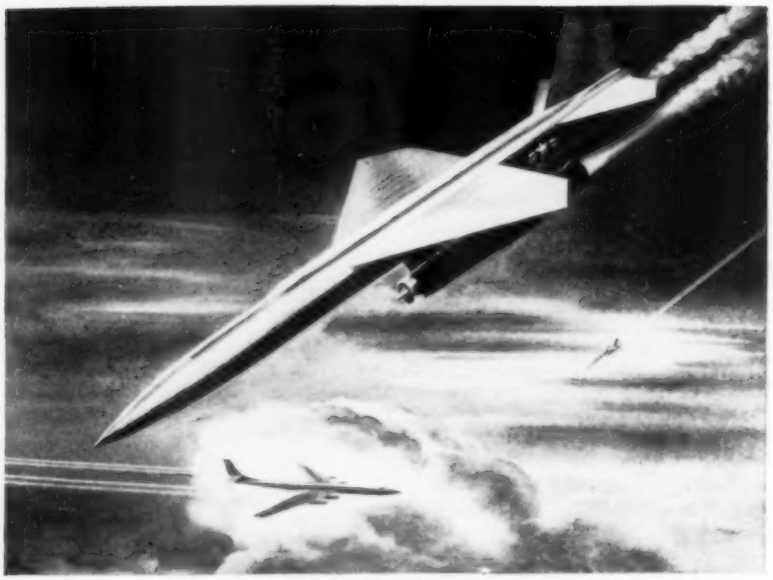

Boeing's Bomarc

Artist's drawing shows latest Boeing configuration for IM-99 Bomarc interceptor missile. Powerplants are two Marquardt ramjets. Boeing has complete systems contract for missile.

Federal Airport Grants Total $39 Million

Washington—Federal grants totaling $38,932,065 for 319 state airport projects have been awarded by the Civil Aeronautics Administration in the second allocation of funds for the Fiscal 1956 federal airport aid program.

The new allotments are in addition to grants totaling $20 million for 205 communities which were made last summer (AW Aug. 29, p. 25).

Programming of another $63 million authorized for the fiscal year beginning July 1 is yet to be announced by CAA.

An airport-by-airport breakdown of the $38.9 million appropriation for the remaining months of this fiscal year follows:

ALABAMA

Birmingham Municipal Airport	$437,232
Montgomery Dannelly Field	299,750

ARIZONA

Bisbee-Douglas Int'l. Airport	$18,291
Clifton-Morenci Airport	32,306
Globe Cutter Airport	6,099
Kingman Municipal Airport	12,198
Phoenix Sky Harbor Municipal Airport	453,027
Oak Creek (Sedona) Airport	12,198
Pinal County Board Municipal Airport	6,100
Tucson Municipal Airport	163,453

ARKANSAS

Camden Harrell Field	$20,000
Conway Municipal Airport	26,000
Harrison Municipal Airport	18,600
Little Rock Adams Field	250,000

CALIFORNIA

Tahoe Valley Airport	$35,000
Auburn Municipal Airport	12,193
Kern County Airport No. 1	177,556
Chico Municipal Airport	13,548
Columbia Airport	11,000
Eureka County Airport	89,096
Half Moon Bay Airport	18,967
Santa Barbara Municipal Airport	6,153
Los Angeles Int'l. Airport	359,463
San Fernando Valley Airport	379,330
Modesto City-County Airport	29,805
Napa County Airport	29,805
Oakland Int'l. Airport	1,000,000
Ontario Int'l. Airport	98,626
Riverside Municipal Airport	95,198
Salinas Airport	54,190
San Francisco Int'l. Airport	411,844
San Jose Municipal Airport	319,150
Orange County Airport	27,095
Stockton Field	105,200

COLORADO

Alamosa Municipal Airport	$4,953
Moffat County Municipal Airport	22,902
Stapleton Airfield, Denver	$569,622
La Junta Municipal Airport	7,300
Lamar Municipal Airport	4,260
Longmont Municipal Airport	37,282
Montrose County Airport	5,326
Nucla—Montrose County Airport	13,315
Sterling—Logan County Airport	9,054

CONNECTICUT

New Haven Municipal Airport	$125,000

FLORIDA

Gainesville Municipal Airport	$5,250
Jacksonville Airport	35,420
Key West Int'l. Airport	182,500
Miami Int'l. Airport	400,000
Fannin Field, Panama City	65,000
Pinellas County Int'l. Airport	233,000
Sarasota—Bradenton Airport	195,000
Tampa Int'l. Airport	150,000

GEORGIA

Atlanta Municipal Airport	$1,000,000
Fulton County Airport, Atlanta	37,500
Covington Municipal Airport	15,000
Baldwin County Municipal, Milledgeville	59,200
Travis Field, Savannah	250,000
Thompson Field, Swansboro	46,250

IDAHO

Idaho Falls Municipal Airport	$47,248
McCall Municipal Airport	8,991
Sandpoint—City County Airport	13,060

ILLINOIS

Civic Memorial Airport, Alton-E. Alton	$20,000
Aurora Municipal Airport	22,000
Benton Municipal Airport	35,000
Bloomington Municipal Airport	30,000
Murdale Airport, Carbondale-Murphysboro	33,000

Centralia Municipal Airport	20,000
Chicago—Midway Airport	87,500
O'Hare Field—Chicago Int'l. Airport	432,500
Vermilion County Airport, Danville	59,000
Dixon Municipal Airport	7,000
Galesburg Municipal Airport	252,000
Jacksonville Municipal Airport	31,000
Williamson County Airport	111,000
Coles County Memorial Airport	120,500
Quad City Airport, Moline	251,000
Mount Vernon Municipal Airport	103,000
Greater Peoria Airport	474,000
Capital Airport, Springfield	35,000
Whiteside County Airport, Springfield	104,000
Dupage County Airport, West Chicago	25,000
INDIANA	
Indianapolis Municipal Airport—Weir Cook	$393,492
Muncie Airport	175,000
IOWA	
Audubon Municipal Airport	$10,000
Burlington Municipal Airport	27,500
Cedar Rapids Municipal Airport	4,625
Davenport Municipal Airport	102,250
Dubuque Municipal Airport	27,000
Mason City Municipal Airport	27,402
Newton Municipal Airport	44,400
Sheldon Municipal Airport	38,553
Sioux City Municipal Airport	50,950
Waterloo Municipal Airport	9,000
Webster City Municipal Airport	9,000
KANSAS	
Cedar Bluff State Park Airport	$32,500
Kanapolis State Park Airport	32,500
Liberal Municipal Airport	12,500
Parsons Municipal Airport	63,800
Salina Municipal Airport	100,000
KENTUCKY	
Bowling Green—Warren County Municipal Airport	$51,750
Greater Cincinnati Airport	453,750
London Municipal Airport	48,250
Owensboro—Daviess County Airport	70,700
Somerset—Pulaski County Airport	48,000
LOUISIANA	
Lafayette Airport	$65,000
Minden Airport	6,000
Moisant Int'l. Airport, New Orleans	1,000,000
MAINE	
Augusta State Airport	$25,000
Millinocket Municipal Airport	10,000
Pittsfield Municipal Airport	40,000
Portland Municipal Airport	60,000
Waterville Municipal Airport	60,500
MARYLAND	
Friendship Int'l. Airport, Baltimore	$259,556
Hagerstown Municipal Airport	37,500
MASSACHUSETTS	
Laurence G. Hanscom Airport, Bedford	$70,000
Logan Int'l. Airport, Boston	565,000
Fall River Municipal Airport	8,500
Gardner Municipal Airport	22,000
Barnstable Municipal Airport, Hyannis	83,750
Martha's Vineyard Airport	6,183
Nantucket Memorial Airport	20,000
New Bedford Municipal Airport	34,375
Norwood Memorial Airport	13,475
Orange Municipal Airport	14,750
Southbridge Municipal Airport	51,000
MICHIGAN	
Ann Arbor Municipal Airport	$55,000
Huron County Memorial Airport, Bad Axe	28,000
W. K. Kellogg Regional Airfield, Battle Creek	100,000
Benton Harbor-St. Joseph Ross Field	51,589
Branch County Memorial Airport, Coldwater	40,000
Iron County Airport, Crystal Falls	50,000
Detroit-Wayne Major Airport	975,614
Bishop Field, Flint	25,000

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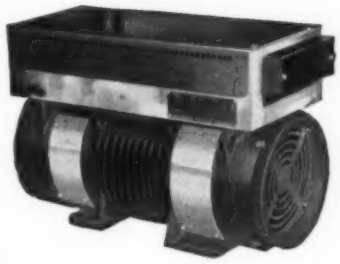

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12128	27.5	1	26	1	6	2.2	35000	AN3496-1
12126	27.5	2	26	3	10	2.3	35000	N1020-SK
MG-93	27.5	12	115/200	1	100	10	65000	E-5134
				3	100			
MG-54	27.5	22	115/200	1	250	17	65000	E-5109
				3	250			
12142	27.5	22	115	1	250	13	35000	E-1617
				3	250			
12146-1	27.5	22	115	1	250	13	35000	53B6239
12146-2	27.5	22	115	3	250	13	35000	AN3532-2
MG-60	27.5	22	115	1	250	17	50000	53B6239
MG-62	27.5	22	115	3	250	17	50000	AN3532-2
32E01	27.5	35	115	1	500	26	50000	AN3533-1
				3	500			
32E00	27.5	37.5	115	1	500	34	50000	AN3534-1
		51.5		3	750			
MG-65	27.5	50	115/200	1	750	35	50000	E53805
		52		3	750			
1518 Mod. 1 & 2	27.5	105	115	1	1500	37.5	20000	—
		126		3	1800			
1518 Mod. 5	27.5	105	115	1	1500	37.5	35000	—
		126		3	1800			
MG-81	27.5	180	115/200	1	1600	61	65000	E1725
				3	1800			
32E06	27.5	150	115/200	1	2250	56	50000	E1725
		160		3	2500			
MG-70	27.5	170	115/200	1	2250	54	65000	—
				3	2500			
MG-61	27.5	170	115	1	2500	54	65000	53C6767
MG-64	27.5	170	115	3	2500	54	65000	—
32E03	27.5	160	115	1	2500	61	50000	53B6227
MG-95	27.5	150	115/200	1	2500	54	50000	E54807
		160		3	3000			
32E09	27.5	180	115/200	1 3	2500 3000	60	50000	—

NOTE: D.C. input voltage shown is a nominal value of 27.5 volts, but all units are designed to operate from 26 to 29 volts. Input amperes shown are values at 27.5 volts input.

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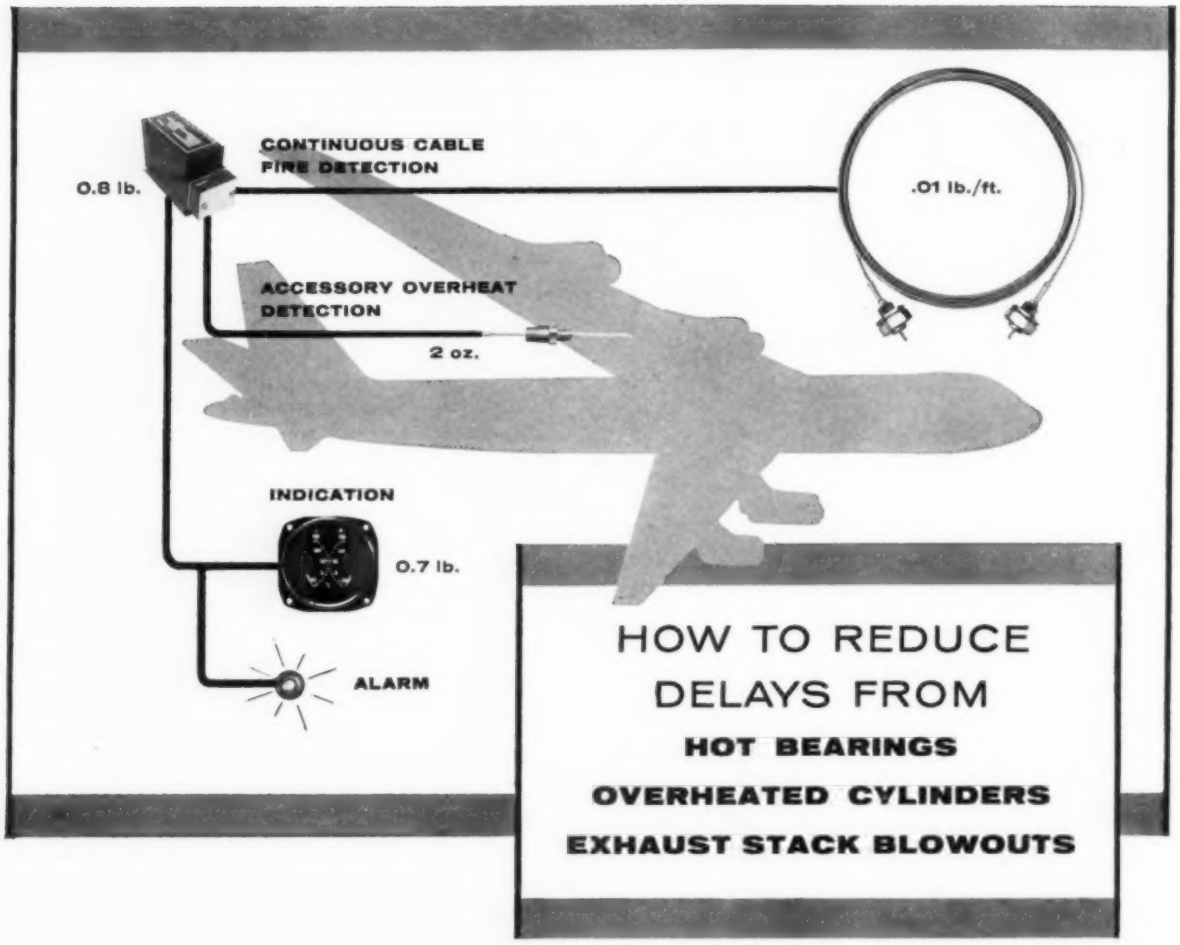

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- **Litton Industries,** $5,647,950 for 1155 pulsed amplifier kylstron electron tubes, type L-3035.
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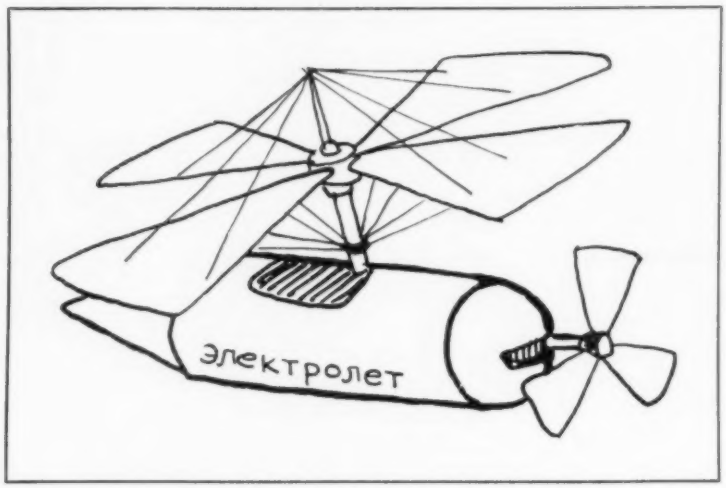
LOMONOSOV'S Aerodynamic of 1754 (Fig. 1).



LADYGIN'S electroflier, designed in 1869, was to be electrically powered (Fig. 2).

Russia's Rapid Helicopter-Design Progress

By Eugene K. Liberatore*

The recent and rapid progress in Russian helicopter design, paralleling that country's speedy development cycle for heavy jet bombers and supersonic fighters, has served to focus intense interest on the rotary-wing phase of Soviet aviation.

Dozens of the single-rotor Hound helicopters have been publicly demonstrated at Tushino in simulated field maneuvers cooperating with units of the Red Army. Also at Tushino, large numbers of twin-rotor helicopters, code named the Horse, showed both military and civil applications by flying in prime movers, followed by aerial delivery of a light Podbeda car.

In the Arctic, Hound helicopters—approximating in design the Sikorsky S-55—are being used for supply and exploration.

Some Western observers have been shocked by what they consider the sudden birth of service helicopters full-blown from the Red aeronautical womb.

What they forget is that Russia—like many other nations—has a background of rotary-wing development that extends back two centuries.

This little-known aspect of Russian aeronautical development provides a fascinating insight into the current generation of Red copters.

Mikhail V. Lomonosov, father of Russian science, physicist, chemist, astronomer, geologist and geographer, was the first to make studies of lifting screws for vertical flight. Lomonosov, who in 1745 had been the first Russian elected to the Russian Academy of Sciences, presented his ideas on vertical flight to that body in 1754.

He showed details of a device for lifting thermometers and other scientific instruments into the air, and submitted a drawing of the apparatus (Fig. 1).

The proceedings of the Academy said, in July 1754:

"The Honorable Advisor Lomonosov demonstrated his invention called AERODYNAMIC to be used for the purpose of depressing the air by means of wings rotated horizontally in the

* *Assistant Director of Engineering, Flettner Aircraft Corp.*

YURIEV helicopter (above) was ground-tested in 1912 (Fig. 6); Antonov co-axial (right) was completed in 1910 (Fig. 7).

ROTOR TESTS by Rykachev (Fig. 3).

VELOCIPEDE by Bykov (Fig. 4).

HELICOPTER by Yuriev (Fig. 5).

Based on Two Centuries of Experience

opposite directions by the agency of a spring of the type used in clocks in order to lift the machine into the upper layers of the air."

The apparatus was suspended from a string and, when the spring was wound, the device rose in the air. On this event Russia today claims priority in rotary-wing experimentation.

For more than a century, Lomonosov's work was the only rotorcraft activity to come out of Russia.

But in 1869, A. N. Ladygin presented his design for a helicopter project to the Central Engineering Agency. He called his apparatus ELECTROFLIER. The fuselage resembled a long cylinder with a cone at one end and a hemisphere at the other (Fig. 2). The hemisphere carried a propeller, moved laterally for propulsion and control. The machine was supported by a lifting rotor. To power the craft, Ladygin proposed an elementary electric motor delivering 300 hp., driving the screws by means of a geared transmission. The Electroflier weighed 500 poods (3,630 lb.). Energy for the motors was to come from storage batteries, which he failed to describe.

After consideration of Ladygin's project, one of the members of the Agency commented:

"Attempts to control an aerostat by means of propellers, sails, and wings, in the manner of windmills have been made repeatedly and have led to no useful results for this purpose."

He concluded that the proposal was "entirely inapplicable in practice."

In 1870, Ladygin left Russia to

ANTONOV PATENT for co-axial rotor helicopter was granted for design work that began in 1909. Craft was built and tested with poor results (Fig. 8).

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further his objective and worked on his proposal for many years. A few months after the start of World War I in 1914, he petitioned the Russian government for a 5,000 ruble subsidy to enable him to produce a machine. By this time, his original proposal had been transformed into an ornithopter capable of carrying one person. The proposal included four paddle wheels. Each paddle wheel was driven by a separate motor. The motors were energized by means of generators driven by a 20 hp engine. The craft had no rudders or elevators. Control was obtained by variation in the power distribution to the paddles. A stabilizing feature consisted of a mercury circuit, which automatically varied the current to the motors if the craft was disturbed by a gust.

Ladygin found a supporter in Professor N. L. Kirpichev, who concluded:

". . . There is no logical basis for assurance that his apparatus will not be capable of flying."

On November 12, 1914, an Army Technical Board, ever hopeful for a new weapon and not anxious to stick their necks out, reached the following conclusions:

"1. If successfully realized, a flying apparatus of the type proposed by the electrical engineer, Ladygin, could be of certain use to the cause of military aviation.

"2. Mr. Ladygin's theoretical considerations and general calculations relating to his apparatus contain no inconsistencies or errors."

The Army failed to provide funds, and the course of the War prevented him from advancing his project. Prior to the Russian Revolution, he emigrated to the U. S., where he died in 1923.

Analysis and Designs

In 1870, M. A. Rykachev, a member of the Academy of Sciences and Director of the Central Physical Laboratory, conducted experiments on air screws to determine their efficiency. (Fig. 3).

In 1888, the scientist E. S. Fedorov published a paper in the Proceedings of the Russian Technological Society. It presented a mathematical analysis of the possibilities of using air screws in flying machines.

An aerial velocipede was proposed in 1897 by I. Bykov (Fig. 4). The craft was a monocycle supported and propelled by means of a helical screw. Power was to be obtained by pedaling the cycle. His proposal was presented to the Aviation Division of the Electrotechnical Committee but was rejected.

In September, 1899, Nikita Mironovich Mitreikin, an artisan from the Moscow district, made public his design for an "Aviation Bicycle." The device consisted of two screws driven by the operator's feet. The inventor claimed he succeeded in lifting the machine one arshin (28 inches) and flying a distance of about 5 sazhens (35 feet).

He offered his invention to the Ministry of War and pointed out that the apparatus "can be of great use in military action, as it will be possible to remove wounded quickly, without shaking or rocking." His proposal added, "As I have not been taught drafting and drawing, it was very difficult for me to think this out and to make it from wood, especially with my hand tools; therefore, much of it is clumsy.

"The learned gentlemen can make it incomparably more elegant of metal, more correct, and neater looking, but nobody can change the practicality and force of action, for I practiced much with the full-sized bicycle. One wheel was made one arshin in size; in place of the claws and pinion, nails were driven and bent; the paddle wheels were made of sticks and covered with linen cloth 1¼ arshins in length, 1½ arshins in width; practicing on it with all its weight, rolling on it, it separated from the ground, i.e. lifted with difficulty and no more than ¼ arshin; then it no longer moved forward; I start working with my feet stronger, it rises higher, I bend down my body . . . i.e. my chest forward, and it moves forward; from this I understand that, working with my feet, it rises upward; bending down forward with my body, it flies forward; although I did not rise high and did not fly much, still I was convinced in practice, and was enthusiastic, that it can lift into the air, fly forward; but in this it puzzled me, that, having risen even half an arshin into the air, it turned me, too, though

Eugene K. Liberatore

This definitive article, prepared by Eugene K. Liberatore, Assistant Director of Engineering for Flettner Aircraft Corp., presents for the first time a complete history of two centuries of Russian rotary-wing activity.

Most of the material upon which this article is based was obtained from Russian sources. This work is to be presented in a different form in forthcoming publications of the Office of Technical Services of the Department of Commerce. These publications, comprising an 18-volume series of rotary-wing handbooks covering the complete art, were edited by the writer for Wright Air Development Center, Air Research and Development Command.

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slowly in the opposite direction of the wings so that, no matter where I start flying, it turned me with my side and back; from this my head turned. Then, I thought up attaching a tail to it but this did no good; then thought up making two additional paddle wheels below the propeller wheels, they quieted it completely; a long time I struggled with them, so that they might be easily raised, lowered, turned in a definite direction; then I thought up wing liners, with which a one-arshin wing liner it is easy to lift a 10 pood (361 pounds) wing but the same wing liners are difficult to operate, for, if they are attached, the wings cannot be properly directed; then I thought up springs, but, no matter how hard I tried, no springs can be made of wood; the lower spring I made somehow, but the upper I could not make; made it of rubber.

"Although I never rose up into the air higher than one arshin, nor flew forward more than five sazhens, still I was convinced of the full practicability.

"Therefore, if my labors are lost, it will be only in case the learned gentlemen pay no attention to my model.

"The second i.e. left wheel is not needed at all; I attached it to make the toothed wheel turn more securely; still, it did no good, it is impossible to fix a wooden thing so correctly. If three aviation bicycles are joined in a row in such a manner that the propeller wings of the middle bicycle are higher than those of the side bicycles, then in operation the compressed air from under the side wings of the middle bicycle will move with terrible force under the wings of the side. . ."

Twentieth Century Work

The new century introduced a number of rotary-wing developments that were comparable in scope to those undertaken in other countries.

In the general field of aeronautical engineering, Russia was a progressive nation. Efforts in aerodynamic research and unusual configurations were equal, if not superior, to the other European nations. But in aircraft production, Russian aircraft and engines were copies of French, British or American designs. There were a few outstanding native designers, the most noted being Igor Sikorsky.

In the early years of the twentieth century, the leading aeronautical engineer was Nikolai Zhukovskii. He came to be known as the father of Russian aviation, but he was also claimed by Poland, under the name of Joukowski. He is known by the latter name in the U. S., especially for his work on the analytical approach to developing airfoil sections.

In 1889, Zhukovskii had set up in Russia the first aerodynamic laboratory as part of Moscow University. In 1902, he added a wind tunnel to the laboratory.

On January 22, 1904, he released a communication "On the Useful Load Lifted by a Helicopter," analyzing the main attempts to solve the problem of twin and multi-rotor helicopters. Zhukovskii wrote, "On the basis of all that has gone before, it must be concluded that, given the present proportionate weight of the engine, a twin-propeller helicopter cannot lift into the air more than a definite useful load; as concerns multi-propeller helicopters, it is clear that with an increasing number of propellers, they can lift any load. Moreover, multi-propeller helicopters designed for the same proportionate engine weight and the same useful load, give lighter weight aircraft with less powerful engines than do twin-propeller helicopters."

In 1909, Zhukovskii gave a series of lectures on the "Theoretical Elements of Aviation" at the Moscow Technical Institute. In 1914 a special class in aeronautics was organized, and some of his students later became leaders in the field of rotary-wing aircraft. Three of them were G. K. Sabinin, V. P. Wetchinkin and B. N. Yuriev.

Little is known of the helicopter work of Sabinin, but Wetchinkin proposed a coefficient in 1913 for evaluation of a rotor in hovering. He called his coefficient Otdatcha and expressed it as:

$$O = \frac{T^{3/2}}{hp. \times D}$$

That form of the coefficient is recognized in the United States as the Figure of Merit.

Yuriev: 47 Years' Work

Of the three early students, Boris N. Yuriev came to be best known. His association with helicopter development has lasted through the Czarist and Soviet regimes. Today, he is looked upon as the patriarch of Soviet helicopter engineering.

Yuriev's helicopter activities began in 1909. In that year, he proposed a

Canadian Sub Hunter

A Royal Canadian Navy HS-50 (Sikorsky S-55) lowers its dunking sonar in evaluation tests off Canada's east coast. The tests are being conducted to help determine the helicopter's role in the Canadian Navy's anti-submarine defense force.

coaxial-rotor helicopter design. In the central part of the fuselage was located a 70 H.P. Gnome rotary engine, which drove two two-bladed rotors of different sizes. The upper rotor was 29.5 feet in diameter, and the lower one 9.85 feet. The machine incorporated a variable pitch "steering propeller" for directional control. Wheels were provided for a running take-off. There were provisions for a parachute in case the engine failed. The weight of the machine was 694 pounds. Late in 1909, a second version was designed. Yuriev estimated 50 H.P. was required for take-off. The inavailability, locally, of power plants of this size precluded the possibility of building a machine.

A 25-30 H.P. Anzani engine was available at the Moscow Aviation Club, and he designed a modern-looking helicopter around this power plant (Fig. 5). It consisted of a single two-blade lifting rotor and a tail rotor. The power plant was installed with its shaft vertical and slightly forward of the main rotor shaft. The drawing shows a power plant much larger than the one contemplated for use. The tail rotor was powered by means of a belt-drive system.

First Tail Rotor

In 1910, Yuriev applied for a patent on his device. A glorification of Soviet helicopter accomplishments in Ogonek magazine, written by Yuriev, cites a Patent Certificate No. 45,212, granted him in 1910. But Russian patents of that era had lower numbers, less than 20,000. Evidently, he cites a patent application number. A check at the New York Public Library's patents from Russia indicates that the patent was never granted. What is more significant, however, is the fact that Yuriev appears to be the first to develop the modern configuration of a tail-rotor helicopter (Fig. 6).

In 1910, Emil Berliner in the U. S. proposed a "GYROCOPTER," which consisted of a single lifting rotor with an antitorque tail rotor. Thrust was

Illustration Only

The organization chart appearing with Ralph Miner's article, "Operations Knowledge Keys Safe Design," (AW Jan. 16, p. 43) was prepared by Aviation Week for purposes of illustration. It was intended to show only one possible organization scheme suggested by the ideas in Miner's article.

In Dr. Campbell's plea for rearward-facing seats (AW Jan. 16, p. 65), the word "extended" should replace the word "prone" in the sentence, ". . . Gravity increases in the prone position can be tolerated up to 200G" (p. 71).

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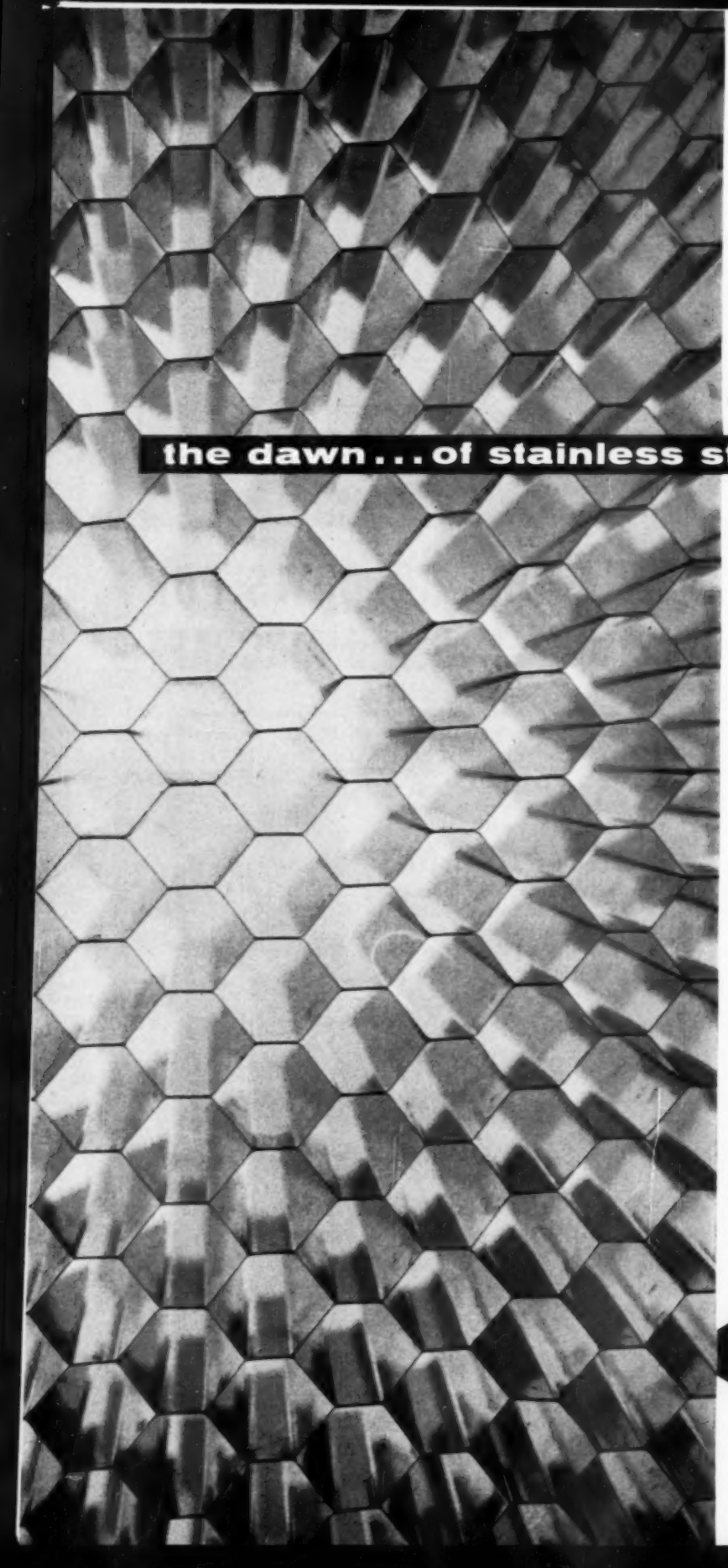

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varied in the tail rotor by varying its diameter.

He soon abandoned this for the coaxial configuration. As a result of his studies, Yuriev presented in 1911 a paper "The Maximum Useful Load Lifted by Airplane and Helicopter with Engine of Given Power".

With the support of the Ledentsov Society, Yuriev constructed a prototype in 1912 designed around the Anzani engine. Figure 6 is an early photograph of the machine. The rotor diameter was 26.2 feet. He had devised a pitch change mechanism, but in order to save weight, it was not incorporated in the prototype.

It appears Yuriev understood the principle of autorotation applicable to helicopters for power-off descent. He writes, "The student, Sorokovnovskii, proved that the blades of a large rotor revolving in air, with the motor idle, serve as a fully reliable parachute and can even be used to land at an angle to the horizon. This was the discovery of the phenomenon of rotor gliding."

The prototype as constructed weighed 445 pounds. However, the forward compartment for the pilot is not shown in the photograph. The craft was displayed at the International Aeronautical and Automobile Exposition in Moscow in 1912. At that time, he distributed a pamphlet, "A Short Description of the Yuriev Helicopter". For his helicopter design, Yuriev was awarded an Exposition gold medal.

The machine was ground tested, and in the course of tests, the main rotor drive shaft failed. Lack of funds forced Yuriev to discontinue the program, and the onset of the First World War and the Russian Revolution prevented further development.

Yuriev later resumed his position as a leader in helicopter development under Soviet rule.

Two for Sikorsky

While residing in Russia, Igor Sikorsky produced two coaxial rotor helicopters.

The first machine was built in 1908 when Sikorsky was a student at Kiev Polytechnic Institute. This helicopter included two two-blade rotors and was powered by a 12 H.P. 3-cylinder Anzani engine. The upper rotor was 15 feet in diameter, and the lower one was 16.5 feet. The rotors turned about 160 r.p.m. Tests showed that the engine lacked sufficient power to lift the machine.

In 1910, a second helicopter was built. This version was powered by a 25 H.P. Anzani. Each rotor was 19 feet in diameter and had three blades. The empty weight was about 400 lbs. This craft could hover its own weight but could not carry the operator.

After the helicopter trials, Sikorsky turned to fixed-wing aircraft, and produced a series of successful airplanes in Russia.

There were other early century helicopter projects and proposals in Russia. In the field of aeronautical engineering, Dmitri Riabouchinsky was a leader. Contemporaries were Gassovskii and

Britannia Flight Deck

Pilot and co-pilot positions in the Bristol Britannia turboprop transport show the relatively uncluttered look of the layout. Flight instruments are duplicated for both pilots. Normal crew complement is four, and a fifth position can be provided by a seat fitted behind the control console and between the pilots' positions. The Britannias are due to enter service with British Overseas Airways Corp. this summer on the route between London and Johannesburg, South Africa.

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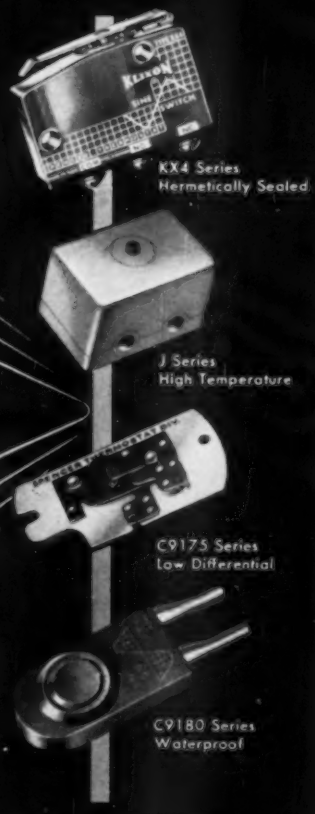

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Antonov, who were more or less active with helicopter projects.

The work of Riabouchinsky is noteworthy because it represents the earliest record of wind tunnel tests of a lifting screw under the influence of a horizontal wind. These tests were conducted at the Koutchino (Tushino) Aerodynamic Institute near Moscow. In one test, a 0.98-ft. diameter rotor was subjected to a wind of 20 fps. at right angles to the axis. The resulting thrust was two and a half times that of a screw without cross flow. This work was published in the 1909 edition of the Bulletin of the Aerodynamic Institute. Subsequently Riabouchinsky emigrated to France and in recent years has been involved in work on jet propulsion systems.

In 1908 Gassovskii submitted a proposal for a helicopter to the Army. The design featured a device for variable pitch control. The proposal was reviewed and rejected.

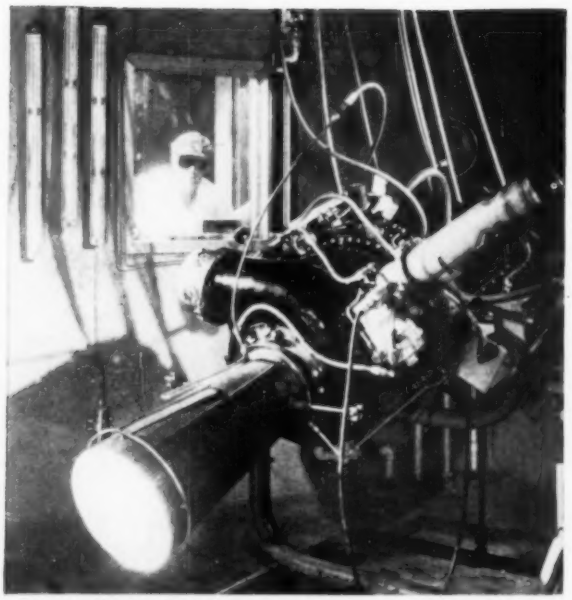
Konstantine A. Antonov had been engaged in aerostate development until 1907 when he turned to the problem of the helicopter. In June 1909, he undertook a program to produce a coaxial rotor helicopter. The craft was built at the Lessner Works in St. Petersburg and completed in January 1910 (Fig. 7). Later, Russian patent 21,172 was granted him on the device (Fig. 8). A tractor screw was included for propulsion, and two multiblade rotors were used. The blades consisted of triangular pieces of aluminum with one point at the hub. Each blade had pivot points at the hub and tip where it was attached to a large ring. This permitted the blades to change pitch. By lowering the pitch of the blades a disk was formed which was intended to safely lower the craft in case of power failure. The prototype was fitted with a 35 H.P. engine. The rotors were driven through a gear transmission system. Antonov conducted lifting tests with the new machine but with poor results. Convinced of the futility of further research, the inventor destroyed it.

(This is the first of two articles by Mr. Liberatore on the progress of Russian helicopter design. Next week's article will describe research and development from the Communist revolution to the present.)

Ryan Receives $4 Million In New Firebee Orders

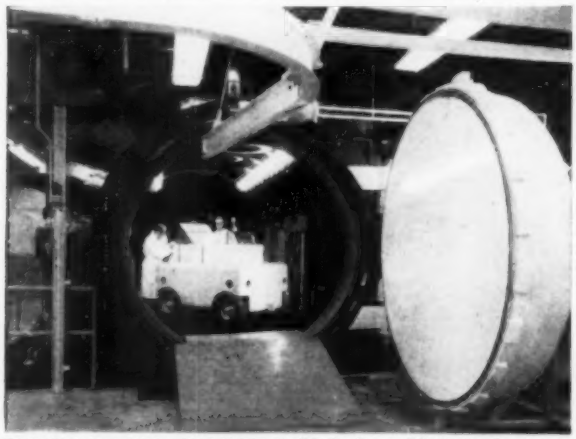
San Diego—The Ryan Aeronautical Co. has received more than $4 million in new Air Force and Navy contracts for an undisclosed number of jet-powered Firebee drone missiles.

The new orders extend production schedules to late 1957, and President T. Claude Ryan said "there are indications" that the company will receive more Firebee orders as the result of current negotiations.

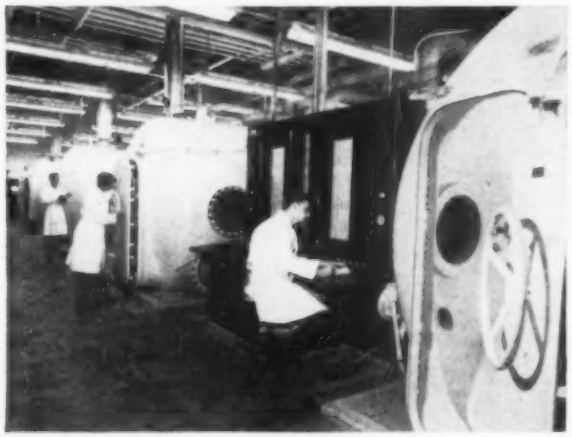


GAS TURBINE ENGINE on test in AiResearch reinforced concrete cell. Up to 35 variables can be recorded simultaneously.

SMALL GAS TURBINES off the assembly line await tests. The new laboratory's main job at present is production testing.



GIANT ALTITUDE CHAMBER is 32 ft. long, 15 ft. in diameter. Trailer starting unit has just been wheeled in for test.



DIVIDED ALTITUDE TANKS simultaneously provide cabin conditions on one side, ambient conditions on the other.

Lab to Test A-Plane Auxiliary Units

Phoenix, Ariz.—A big new $5-million test laboratory which will be used to prove auxiliary power units for atomic-powered aircraft has been put into operation here by AiResearch Mfg. Co. of Arizona, a division of the Garrett Corp. The company already has three contracts—two Air Force and one Navy—to develop such units.

The Navy contract is for a 2,000-hp. unit now in the design stage, AVIATION WEEK has learned. The Air Force equipment would have lower ratings.

The largest auxiliary power unit now under development at AiResearch is a 1,000-hp. machine for the Douglas YC-132 transport. This compares with the largest unit now in production at the company—a 300-hp. configuration.

At present, the laboratory is operating as a production test facility, used routinely for auxiliary power gas turbines, air turbines, air turbine starters, pneumatic controls, cabin pressure regulators, hot and cold air valves, refrigeration turbines, and heat transfer systems, as well as complete systems using these components. However, the facility will not be limited to testing production articles only.

Among the major installations in the test laboratory:

• **A large chamber** for altitude and cold and hot tests. It measures 15 ft. in diameter and is 32 ft. long. Altitudes up to 75,000 ft. can be simulated at temperatures from −65 to 500F. Air flow rates up to 350 lb. per minute are available.

• **Six cabin altitude tanks,** each measuring 9 ft. in diameter and 15 ft. long. They are divided in the middle to create cabin conditions on one side and ambient air conditions on the other side. Air flows up to 200 lb. per minute are available. The tanks are used for testing cabin pressure regulators and superchargers.

• **Four accessory cells,** instrumented to test gas turbine controls and heat transfer equipment.

• **Three cells** fitted to test fuel nozzle patterns, flow quantities and related characteristics.

• **Fourteen valve test sections,** with compressed air supplied at 250 to 1,000

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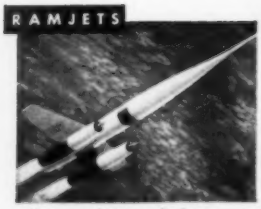

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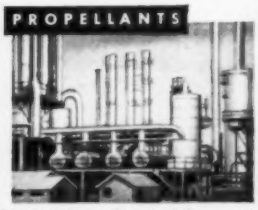
PROPELLANTS



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psi., temperatures up to 1,000F, and flow rates from 15 to 250 lb. per minute. Test cells can be set for ambient discharge or for altitudes up to 75,000 ft.

• **Twelve pneumatic control test stands** used to prove controls for valve systems.

All the laboratory's test equipment is designed and manufactured in an instrumentation area, which includes a machine shop.

Titanium Knowledge Lags Behind Need

Technical knowledge of titanium lags behind industry demand for the metal and its alloys, was the conclusion of a symposium attended by representatives of five major titanium suppliers at the Des Moines, Ia., plant of Solar Aircraft Co.

The symposium dealt with fabrication and other problems concerning titanium, some alloys of which have been in mill production less than one year.

Symposium discussions covered these points:

• Bend strength and formability of titanium sheets are not yet uniform and will vary from sheet to sheet. Suppliers still are working on rolling of high-strength alloy sheets that will vary less than 5 to 8% from true flatness.

• Technical standards for analysis of titanium and its alloys have not yet been established, and are needed to speed progress.

• Supplies of special shapes and types of titanium cannot be obtained as rapidly as needed.

• Titanium producers are working on development of specialized alloys for forging, sheet metal fabrication and other requirements.

• Suppliers of titanium are still on a learning curve.

Solar is producing six major jet assemblies and many detail parts from titanium, and has orders aggregating several million dollars for titanium fabrication.

Suppliers represented were Rem-Cru Titanium, Inc., Republic Steel Corp., Titanium Metals Corp., Sharon Steel Corp. and Mallory-Sharon Titanium Corp.

Boeing Announces Expansion Program

Boeing Airplane Co. has announced plans to build a new $21 million developmental center at its main plant in Seattle and a $8.5 million manufacturing and office facility at Renton, Wash.

The developmental center, which will add 1,021,000 sq. ft. of covered area to the Boeing operation, is scheduled for completion by the fall of 1957. Phases of the Bomarc project, physical research, structural testing and experimental activities are among the functions which will occupy the new area.

The Renton facility will cover about 558,000 sq. ft. Major portion of the site will be used for assembly of body sections of Boeing's 707 jet transport. The offices in the facility will house the company's new Transport Division.

Photography at 45,000 ft.

Nose camera of a McDonnell RF-101A, USAF's supersonic reconnaissance plane, took the above, sharply defined photograph from 45,000 ft. showing the Missouri River near Washington, Mo.

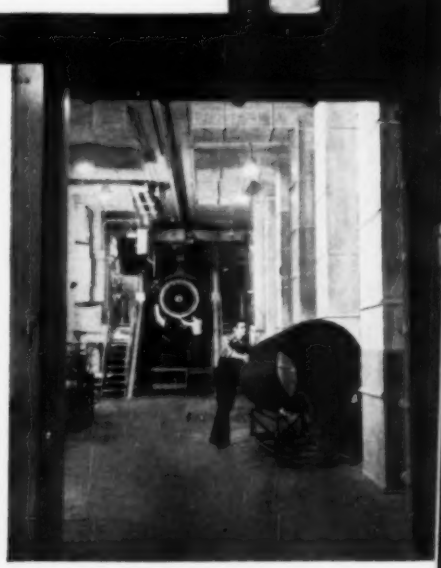
At Evendale plant, specialists learn . . .

HOW TO SERVICE G.E.'s NEWEST ENGINE —THE J79 TURBOJET

Experience on J47, J73 engines enables G-E training school to ready technicians for advanced, high-performance powerplant

PROPER USE OF ENGINE TOOLS is taught at factory school. Those above are used to assemble and disassemble G-E J73. Average of 250 special tools are needed to service jet engine.

FULL-SCALE ENGINE ASSEMBLY is learned through on-the-spot study of G-E turbojets. The G-E engine above rated in 9000 lb thrust class, has been built up 42 times in past year. Students are installing turbine wheel.



FACTORY TEST METHODS are part of 10-week course, where each student puts in 16 hours at test cells. Instructors can set up engine problems for students' solution.

UP TO 10 WEEKS, INSTRUCTION on G-E jets is given to engineering and technical people who attend G-E factory engine school. After graduation, students put know-how to work in military maintenance shops, at special test sites, or on G.E.'s assembly and overhaul lines. Training helps assure reliability of G-E J73 and J47 (above).

If you were to attend General Electric's factory engine school at Evendale, Ohio, this year, you would look forward to studying G.E.'s newest, most powerful turbojet—the J79.

Since 1953, over *1100* jet engine specialists have graduated from the school. They learned (1) maintenance and overhaul procedures for G-E J47's and J73's; (2) how to "trouble-shoot" those engines, and (3) how to instruct others, if required.

Now—and all through 1956—courses on J79 installation and operation, as well as J79 accessory systems, will be conducted, in addition to those on the J47 and J73. Besides 250 G-E field service engineers, many other personnel will attend from the Armed Services, airframe companies, and the NACA.

The Evendale factory engine school is an excellent example of how G.E. backs up its turbojets. For General Electric, while continuing to provide trained specialists for 35,000 engines *now* in the field, at the same time prepares for future service needs of newer engines. General Electric Company, Cincinnati 15, Ohio.

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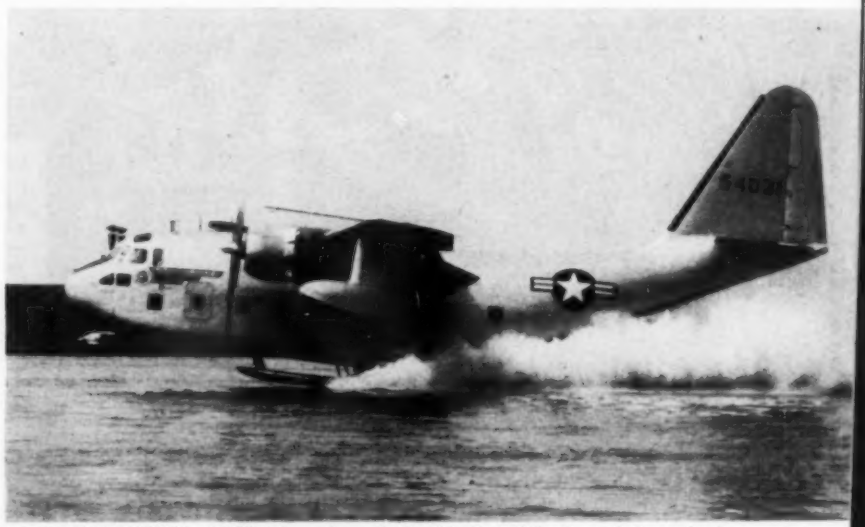
HYDRO-SKIS on Stroukoff Pantobase (all bases) fit snugly against C-123 fuselage while aircraft serves as land plane.

C-123 Pantobase, Flow-Control Research

Stroukoff Aircraft Corp., W. Trenton, N. J., is experimenting with two different systems designed to significantly improve the capability of the C-123 cargo aircraft.

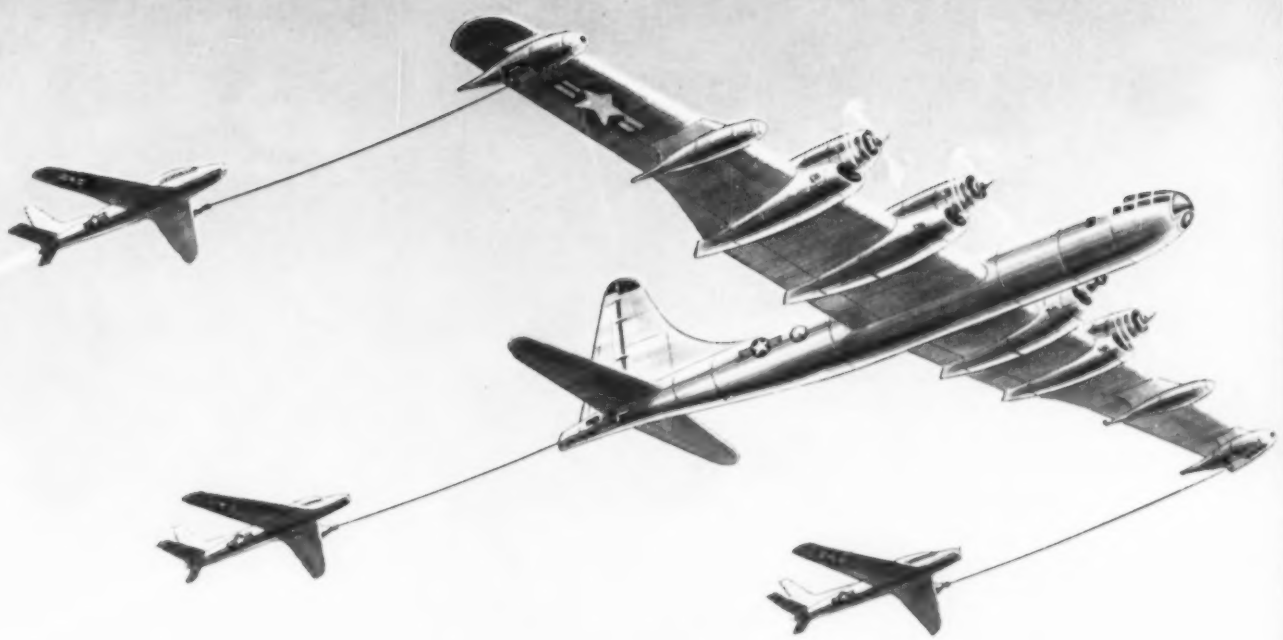
Pictures above, right and lower left show Stroukoff's converted C-123 during test runs of its retractable hydro-skis. The Pantobase configuration (AW Aug. 8, p. 18) gives the aircraft the capability of operating from water and unprepared landing strips.

Picture at lower right shows the company's C-123 fitted with boundary-layer control. The Stroukoff system uses a Continental-built Aspin 2 ducted fan as the air pump. The boundary-layer control gives the aircraft a higher-lift coefficient at slow speeds and improves its short-takeoff performance.



AS AN AMPHIBIAN, C-123 takes off on hydro-skis that slide down below wheels.

PANTOBASE C-123 (left) taxis onto ramp at end of test run. At right, another Stroukoff C-123 tests boundary-layer control system.



hungry "pups"

Like hungry pups, three Air Force jets at the same time nuzzle up to this big KB-50 Hayes-modified tanker for refueling. Unlike the pups, the three jets have been given by Hayes Aircraft engineers the advantage of simultaneously refueling in flight — thus saving precious time needed for a vital mission.

This 3-point "Probe and Drogue" tanker carries a fuel load of almost 25 tons and refuels 3 jets in a matter of minutes. To operate its pumps, it generates enough electricity to light approximately 100 homes. Its design called for solution of engineering problems in aerodynamics, aerophysics and electronics by Hayes Aircraft engineers.

HAYES ENTERS COMPETITIVE FIELD

Hayes Aircraft Corporation has been changed from a command facility, operating under a management contract, to an industrial facility. Under this concept, Hayes now enters the competitive field for engineering, designing and manufacturing. A large multiple-bay plant, modern equipment, engineering know-how and skilled craftsmen give Hayes one of the most versatile and efficient aircraft modification facilities in the Nation.

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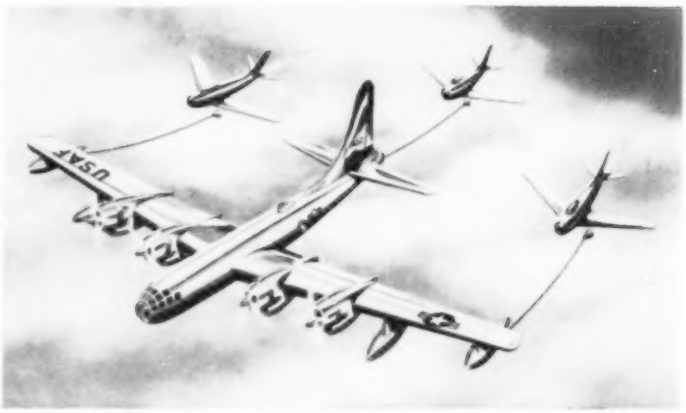
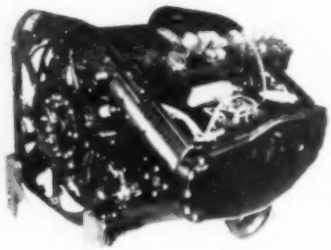
EXCELLENT OPPORTUNITIES OPEN FOR ENGINEERS—SEE PAGE 68.

B-50 TANKERS MODIFIED FOR TAC BY HAYES REFUEL WITH PROBE AND DROGUE SYSTEM DEVELOPED BY FLIGHT REFUELING INC.

Hose reel units, nozzles and couplings developed and manufactured by Flight Refueling Inc. are used in the new multi-point tanker program now being undertaken for the Tactical Air Command by Hayes Aircraft Corporation, Birmingham, Alabama. The Probe and Drogue system, pioneered by Flight Refueling Inc., permits transfer of fuel at high rates of flow, at high speeds under all operating conditions. Its automatic features eliminate the need for trained operators, make possible multiple refueling operations. Flight Refueling Inc., pioneer and leader in the field of aerial refueling development, is proud to supply the vital components for TAC's new tanker program.



These FLIGHT REFUELING Inc. components make up Probe and Drogue system



A-12B hose reel units, mounted in tail and wing tips of B-50, automatically reel out hose, transfer fuel at rate of several hundred gallons per minute. Qualification test reports have been submitted to WADC.

MA-2 coupling, mounted in drogue, and MA-2 nozzle, mounted in probe of receiver, permit automatic fuel-tight connection between tanker and receiver. Probe and Drogue system was pioneered by Flight Refueling Inc.

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Fascinating, new projects to develop new long-range flight systems present unusual career opportunities for engineering personnel. Write Engineering Manager for further details.

Flight Refueling Inc.

FRIENDSHIP INTERNATIONAL AIRPORT
Baltimore 3, Maryland

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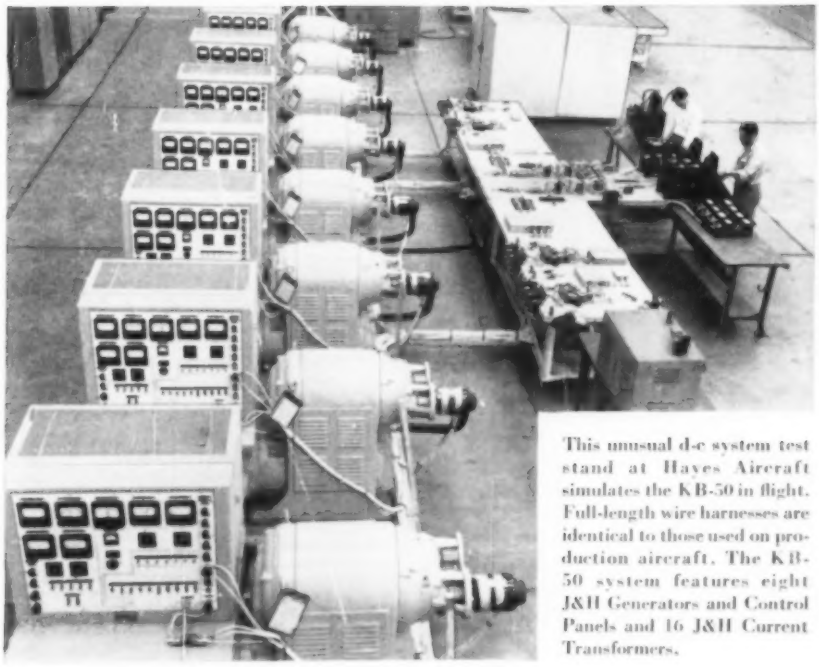


This unusual d-c system test stand at Hayes Aircraft simulates the KB-50 in flight. Full-length wire harnesses are identical to those used on production aircraft. The KB-50 system features eight J&H Generators and Control Panels and 16 J&H Current Transformers.

8 Jack & Heintz Generators paralleled in unique d-c system!

. . . engineers achieve 78% more power for KB-50

The KB-50 will have tremendous refueling capacity. Plans call for fueling of three planes simultaneously.

In converting the Boeing B-50 Superfort into the KB-50 mid-air refueling tanker, a substantial power boost was needed to drive the array of rapid-transfer fuel pumps honeycombed throughout the plane.

The approach lay in developing a new higher rated generator or in paralleling eight available 400-amp machines.

The Jack & Heintz G23 d-c Generator proved to be the answer. Rugged enough to withstand the high vibration characteristics in the KB-50, this generator required only a specially machined housing and a modified mounting flange.

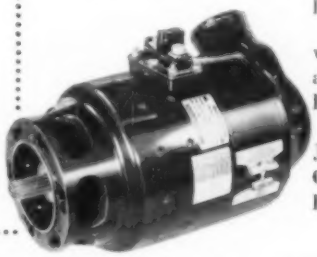
Through the use of the G23, Hayes and Jack & Heintz engineers have achieved a power supply of 3200 amps in the same available space once yielding a maximum of 1800 amps. The unprecedented paralleling of eight generators has been test-proved completely reliable.

Also available is a modified G23 with an increased rating of 450 amps, which is ideally suited to airline applications.

For complete information, write Jack & Heintz, Inc., 17635 Broadway, Cleveland 1, Ohio. Export Dept.: 13 E. 40th St., New York 16, N. Y.

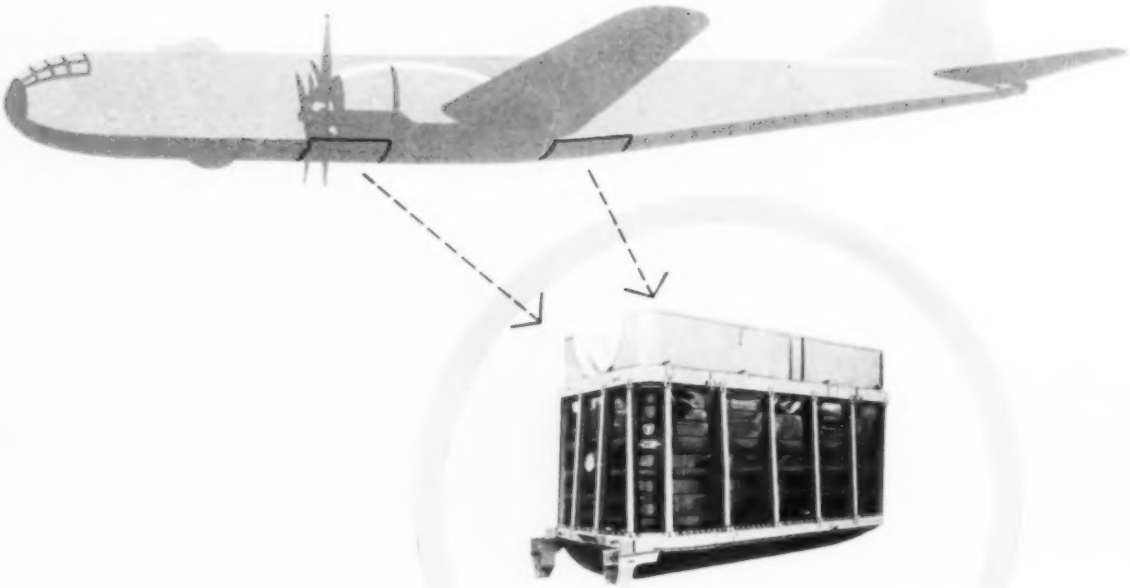
Jack & Heintz G23 Generator

Rating—amp	400
Voltage—d-c	30
Speed Range—thousand rpm	3.8-8
Weight—lb	67
Dimensions—inches	
Over-all Length (from mounting flange)	13 31/32
Over-all Diameter	8
Bolt Circle Diameter	5
Spline, Pitch Diam	.8
Air Inlet Conn., OD	3
Cfm of Air at 6" H_2O & 6000 rpm	165
Rotation as Viewed from end Opposite Flange	CW



©1956 by Jack & Heintz, Inc.

JACK & HEINTZ *Rotomotive* AIRCRAFT EQUIPMENT



"Drape shape"
fuel tank assemblies
lighten the load

Each jettisonable Firestone tank assembly in the KB-50 has a drape-construction fuel cell of two-ply nylon impregnated with Buna N rubber .036" thick . . . weighing only 0.22 pounds per square foot.

FIRESTONE'S CONTRIBUTION TO THE KB-50 REFUELING TANKER

Exclusive drape construction of bladder cells in the Firestone tank assemblies in fore and aft bomb bays of the KB-50 reduces over-all weight approximately 600 pounds as compared to metal tanks of the same capacity.

This service-proved drape construction – originated seven years ago by the Fuel Cell Division of Firestone – reduces weight by eliminating backing material. It lowers initial cost. And it lowers installation cost, since assemblies may be placed in cavities without providing 100% support. Fuel loads between structural members are carried by the cell wall.

In addition to the KB-50, Firestone lightweight, drape-construction fuel cells have been used successfully in the B-45, B-36, B-47 and B-50. More recently, they have been chosen for the KC-135 and F-104.

This engineering know-how is at your disposal.

FUEL CELL
DIVISION

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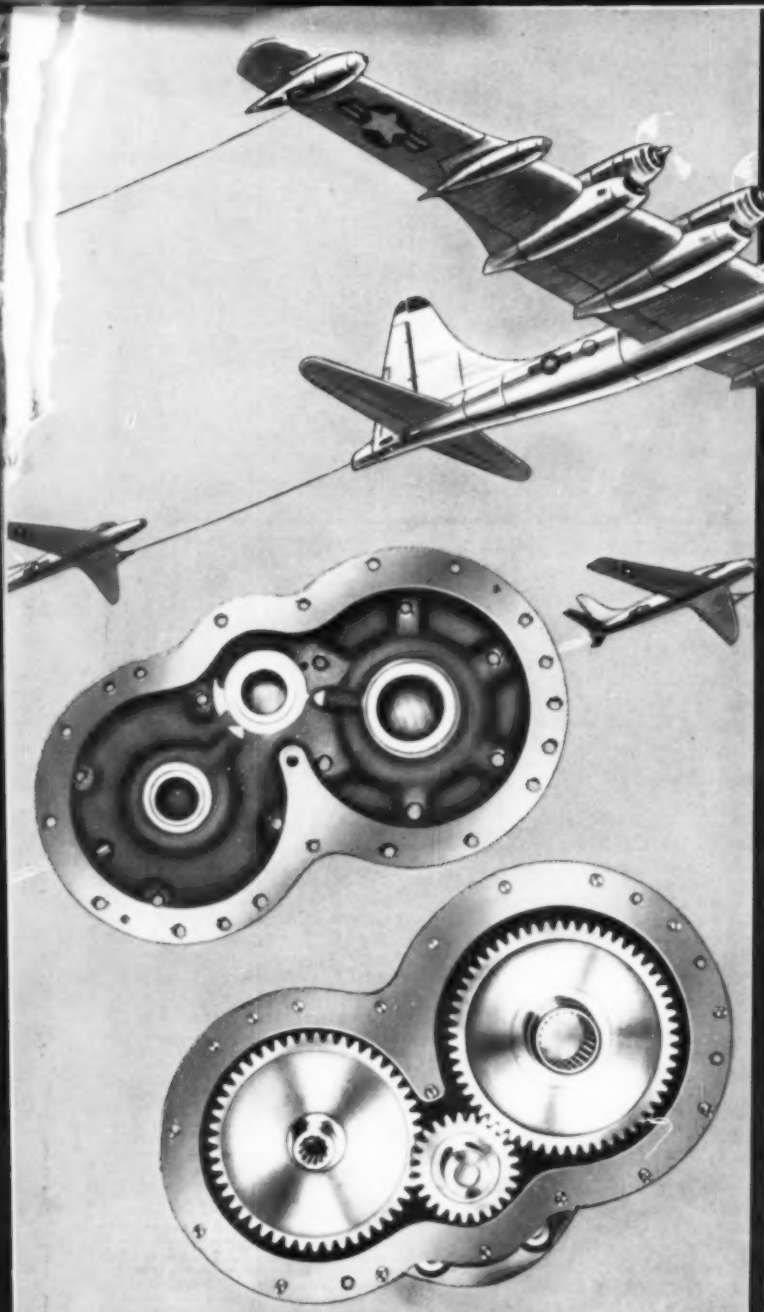
LOS ANGELES 54, CALIF.



Link in a life line

For a rugged, dependable gearbox —key part in the refueling operation of its KB-50 "tanker"— HAYES AIRCRAFT CORPORATION looks to Avco Lycoming!

Now, fuel-thirsty Air Force jets can drink their fill in mid-air—*three at a time*—fed by the Hayes-modified KB-50 tanker!

To design and manufacture the vital KB-50 gearbox, which actuates the flow of fuel, Hayes looked to Avco Lycoming. The result—a gearbox which functions in limited space, with minimum weight was produced by Avco Lycoming—in minimum time!

Do *you* have difficult engineering problems? Do you need sure, dependable power plants for aviation or industrial use? For fast, capable answers, put Avco Lycoming in action!

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Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Miles,
Senior Member, Aviation Writers Assn.

When three jet fighters nuzzle up simultaneously to as many refueling hoses trailing from a Hayes-modified KB-50 multipoint tanker, five specially-designed Whittaker valves stand ready to go to work for the trio of thirsty scrappers.

Motor-operated gate types of three-inch tube size, the Whittaker units incorporated into the Hayes probe-and-drogue system are all identical, each one serving as a shut-off valve near the pump for an individual fuel cell in the tanker's fuselage.

The valves handle pressures greater than that of the average fire hydrant, their slides controlling anywhere from a standard 120 pounds per square inch to a maximum 200 psi. They operate in one second—or less—to free the rushing JP4 through the 80-foot reel lines or chop it off instantly and automatically when the fighters are through drinking.

The Whittaker units were designed and built specifically for the Hayes system which demands fast, definite and dependable action. They must prevent pressure surge and at the same time provide thermal relief through small secondary valves that bleed off excess fuel that might be trapped and heat-expanded.

An additional feature is a manual override, a short lever arm that juts from the actuator to move automatically with the slide as it opens and closes the line. If an electrical power failure should prevent automatic functioning of the valve, it can be cycled quickly by hand.

Hayes Aircraft launched its probe-and-drogue development at the Birmingham, Alabama, plant in 1953, first modifying a B-29 into a KB-29 to carry the bomb bay tanks and the interlaced system of lines, valves, booster pumps and controls that channeled fuel to hose reels in the tail section and the two wing-attached pods.

But although the system worked perfectly, refueling three fighters simultaneously, it was found the veteran old Superfort was too slow, its ceiling inadequate, to handle the fast-flying jets within desirable limits of operation.

Recognizing the value of the Hayes development, the Air Force gave the Alabama company a contract to modify an undisclosed number of faster, higher-flying B-50's with the same system (fifteen were in process through last December when the prototype KB-50T made its maiden flight), and Whittaker was assigned the job of turning out hundreds of shut-off valves as an integral part of the probe-and-drogue operation.

The Hayes modification changes the internal configuration of the big, four-engine ship greatly, touching virtually every part of the aircraft and involving removal of the wings and vertical stabilizer, beefing up the plane's skin in several areas, installation of racks, supporting structures, plumbing, electrical assemblies and other components preparatory to fuel tank placement in the bomb bays.

Subassembly stations along the main production line turn out the new reel-equipped tail structures, reel pods for the wings, and fashion drop tanks in addition to conducting all repairs under an "Inspect and Repair as Necessary" program.

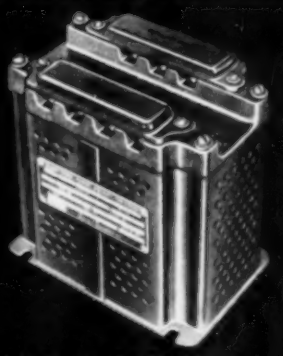
From final assembly the KB-50 emerges as a converted and ready-to-go multipoint tanker that can rendezvous with a trio of fighters, trail out hose lines from wing and tail reels while Whittaker valves open the flow of fuel pumped from the bomb bay tanks.

The lines reel in and out – within limits – as refueling is accomplished between the slightly swaying planes. Then, when the satiated jets pull clear, an automatic braking action is set up which relays a close order to the Whittaker units and simultaneously activates a valve in the drogue as it clears the fighter probe.

Whittaker is proud to have a small share in the success of the Hayes multipoint system and welcomes a chance to salute the engineers and the production personnel of the Alabama company for a job particularly well done.

Among them are W. B. (Bill) O'Neal, Vice President of engineering; Paul Keefer, head hydraulic group engineer; Bill Monroe, fuel system group engineer; G. A. Lindholm, head of the KB-50 multipoint tanker production line, and Preston (Pete) Wilmoth, chief buyer.

NEW A-C POWER TRANSFORMER



First of J&H line... betters Spec MIL-T-9219

Now in use on such leading aircraft as the Boeing B-47 and Consolidated Diesel Electric's and Beech's MD-3 ground power units, the Jack & Heintz GC150 wye-to-delta power transformer has passed all qualification tests.

Designed to MIL-T-9219, the transformer offers a higher guaranteed efficiency and closer regulation than required by the specification.

ENGINEERING DATA

Rating	1.5 kva at 0.8 pf
Frequency	380-440 cps
Primary Voltage	200 volts L-L
Secondary Voltage	115 volts L-L
Guaranteed Efficiency (25°C ambient)	93%
Regulation at Rated Load	4%
Five-Minute Rating	2.25 kva at 0.8 pf
One-Minute Rating	3.75 kva at 0.8 pf
Ambient Temperature	-65°C to +71°C
Altitude	50,000 ft (0°C)
Weight	6.5 lb

For complete design details or for information concerning the availability of power transformers in other ratings, write Jack & Heintz, Inc., 17635 Broadway, Cleveland 1, Ohio. Export Dept., 13 E. 40th St., New York 16, N. Y.

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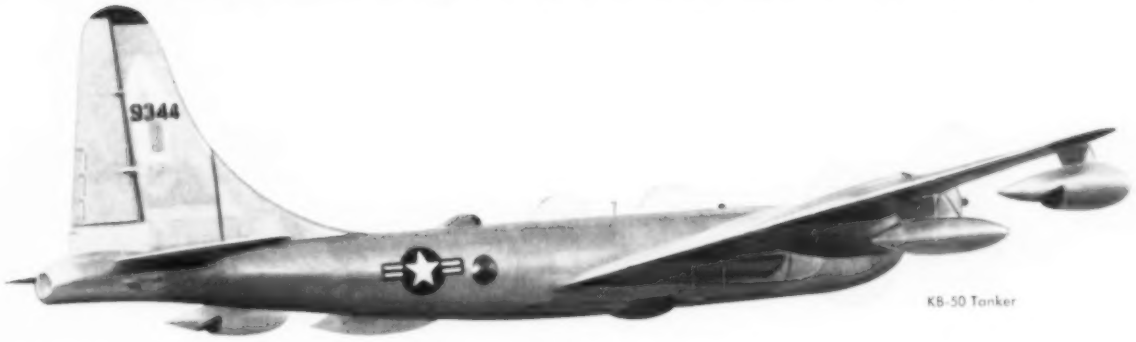
JACK & HEINTZ
Rotomotive AIRCRAFT EQUIPMENT

Hayes Aircraft chooses AUTO-LITE 350 WIRE for use in Air Force KB-50 Tankers



KB-50 Tanker

Withstands −80°F to +400°F temperatures

Designed to meet exacting requirements of military aircraft, AUTO-LITE 350 General Purpose High Temperature Aircraft Wire has been specified by still another leading aircraft manufacturer. Hayes Aircraft Company will use AUTO-LITE 350 Wire on one of the first major military orders for Probe and Drogue refueling equipment . . . the KB-50 Tanker.

Aircraft manufacturers are finding AUTO-LITE 350 Wire reduces over-all production costs compared with other high temperature wires. It was perfected for rugged duty . . . at sea level or at 60,000 feet . . . from frigid −80°F to torrid 400°F. It offers resistance to abrasive wear, flame, solvents, fuels and lubricants. Write for full information on AUTO-LITE aviation wire, including specifications and samples of this superior product. **APPROVED IN SIZES 22 THRU 2/0**

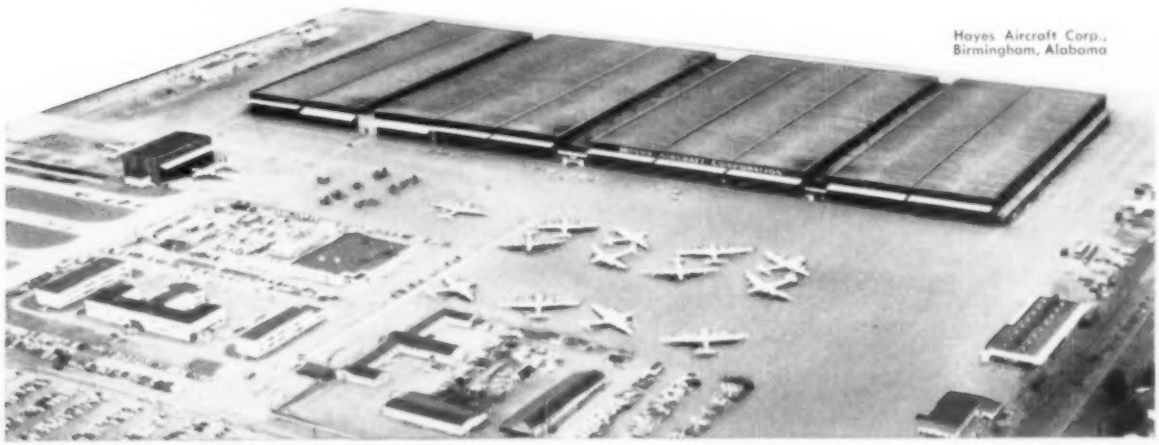
• Flexible at −70°F • Smokeless • No discoloration at maximum operating cable temperatures • In normal installations, this wire is satisfactory at −80°F, or at an altitude of 60,000 ft. as measured at the equator • Resistant to modern aircraft hydraulic fluids, lubricants and fuels for both reciprocating and jet-type engines • Flame-resistant • Easy printing of circuits with conventional marking machines • Free stripping • Meets Spec. MIL-W-8777, U.S.A.F.

AUTO-LITE 350 GENERAL PURPOSE HIGH TEMPERATURE AIRCRAFT WIRE

THE ELECTRIC AUTO-LITE COMPANY

Port Huron, Michigan — Hazleton, Pennsylvania

Wire and Cable Division


Hayes Aircraft Corp., Birmingham, Alabama

FOR RELIABLE ALTITUDE REFUELING THE B-50 RELIES ON NASH

It is significant that for in-air refueling the new Hayes B-50 relies upon the A-2 Nash Centrivac Fuel Transfer Pump. This large tank mounted pump is capable of delivering 600 gallons per minute against a pressure of 125 pounds per square inch gauge. Operating on the same basic principle as the successful Nash Centrivac Fuel Booster Pump, it will deliver clear liquid at discharge, regardless of an entering mixture containing air, gas and vapor in large proportions, as when handling boiling fuel. Vapors are condensed, and any non-condensibles are automatically ejected and returned to the tank.

Under the unstable fuel conditions at altitude, it reliably delivers fuel directly from the tanker storage to the receiver plane. This pump represents another notable Nash contribution to flight advancement.

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Britain's Aircraft Needs: Part IV

Industry Leaders Swamped by Tradition

By Sir Roy Fedden

The (British aircraft) industry for the most part is controlled by men who came into it in its early wood and fabric days, and it must be immensely difficult for them, having lived through two wars and done a very fine job of work, to adjust themselves to the modern requirements with a vastly different tempo; in fact, I should think it was quite impossible for them to do so.

Some of the aviation pioneers are doing a disservice to industry by throttling their firms, because they want to keep everything in their own hands, be it design or top management. In consequence, little promotion takes place either for experienced or promising personnel, which results in the technical and administration strength of the company being stultified.

The British aircraft industry should be a dignified world-wide institution, and however well its leaders have served the country in the past, it is submitted they have not shown sufficient leadership since the War to meet our needs by debunking tradition where necessary and facing up to facts in regard to the volume of work that can be executed in a given time.

Also, for the most part they have failed to spot and bring on the right executives and lieutenants to succeed them.

Need for Pruning

Whether we like it or not, industry has got to make the best of the leaders it has got for the time being, but it should insist on them realising that things cannot go on as they are, or in a very few years from now British aviation will count for very little indeed.

Those holding the reins today must face up to reasonable rationalisation to meet immediate needs until an entirely new plan for the future can be worked out entailing fresh leaders and a fresh production technique.

I believe we have too many major aircraft firms and too many projects in the military field. Everything is spread too thinly, particularly in the technical and engineering departments.

There must be rationalisation, combination and concentration on a few vital projects. In the process of pruning we must ensure that those projects which are retained are really needed, and once settled there must be no further looking over the shoulder. The few selected types executed properly will prevent the present vast waste of time and money and get us somewhere and stop us drifting.

Sweden outstandingly, and also Canada, are examples of countries that knew what they wanted, made reasoned and definite decisions, and saw to it that these were carried through without all the vacillations we have seen here in the last decade.

Bad but Not Hopeless

If we take the United States as our yardstick and compare the size of their aircraft industry and the range of types in manufacture, it is obvious that we are either incomparably more efficient or we should not be attempting to do nearly so many jobs.

We have on hand today twice as many aircraft as it is possible for us to undertake and phase into production in time to avoid obsolescence.

In order to concentrate our efforts and work efficiently it is suggested that we should do better with three engine firms and six airframe constructors. This suggestion would not embrace the smaller ranges including feeder, training and personal aircraft and engines.

This all sounds like an extremist view that things are very bad indeed. Let us be honest. They are certainly very bad but not hopeless; although they will be in a few years' time, if it is thought possible to get back on to the top line, and keep there, by nibbling and only making no more than small adjustments.

Why I believe it is possible to be hopeful for the future is because of the nucleus of trained, disciplined engineers with unbeatable creative and inventive capacity that exist in the British aircraft industry today.

So far it has seemed impossible to find enough of these men and two of the factors which have stood in the way are: The missing generation of World War I, and the big expansions in other engineering industries, again without the foresight and long-term planning for trained personnel.

Tomorrow's Aircraft

But I believe time will find the men, and given the opportunity and right encouragement, the necessary executives will be found, possessing original, vigorous and courageous thought. This will not just happen, however, and something has got to be done about it.

I would here like to refer to the coming of a new set of conditions in the construction of future aircraft which will entail profound changes in the whole approach to manufacturing problems. It is impossible to do more than touch very briefly on these matters as each facet—and there are many—requires a paper on its own. They are, however, to me, very exciting and provide another reason for being optimistic for the future, as I feel they fit exactly into our British philosophy.

In the future, the number of first-class aircraft, whether military or civil, which we shall have to build will be in smaller batches and they will become more and more of a traditional engineering structure. At first sight, if we follow out the prevailing very expensive tooling technique so successfully and lavishly expounded in U. S. A., these changes would seem to indicate a serious further setback for us, and it would appear as if it would be more difficult than ever to keep our end up on this new family of aircraft.

The tooling costs would be stupendous and might rule out any prospect of Britain embarking on production of these types, if traditional methods had to be employed.

Radical Production Changes

But if it is possible to envisage production methods undergoing a radical change by the introduction of a new technique, greatly simplifying or eliminating this serious tooling bogey, then an entirely new vista might be opened up which is not only well suited for these advanced aircraft but would also be practical for short batches, reduce the lead time in the production of prototypes and exactly fit into the philosophy of the traditional British craftsman.

This all sounds idealistic and too good to be true, but you have already heard a paper on lofted templates in the place of drawings and this practice is growing and will materially assist matters.

There also was another paper two years ago at this Conference, when it was explained that large complicated machine tools are not necessary for the production of bulky components in light alloy, and that simple tooling can be used.

Heavy duty routers employing rudimentary locating fixtures and templates will produce complicated sculptured components, and the templates themselves can be readily made on specially designed template machines.

By further extending these proven

Important things are happening at Bendix-Utica

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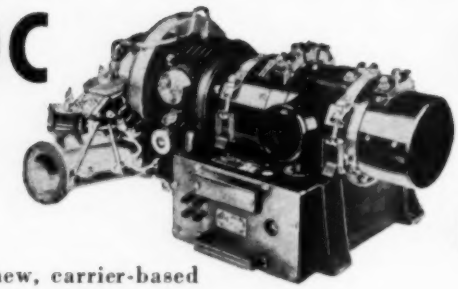

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methods, and by introducing the automatic control of the machine tools employed by suitable electronic means, the possibility is afforded of producing one-off components, or batch quantities of items of a complicated nature in a simple way.

Automation Potential

The part to be manufactured will have to be described either numerically or mathematically and the information coded and fed into the director control of the machine tool.

These coded directions are interpreted in the form of electrical pulses, which control the servo motors operating the machine tool slides, thus bringing about the guidance of the work-piece, or the tool. Of late a great deal has been heard about automation, a word which is not yet in any dictionary but soon will be. The use of numerical or automatic control for machine tools which has just been described does not properly come under true automation.

For simple two-dimensional regulation of machine tool slides or for drilling by co-ordinated means, numerical control by the use of teleprinter tape is possible.

Machine Conversion

There are many approaches to the electronic control of machine tools, and it may well be that eventually standard kits of parts will be on the market at reasonable prices, which will enable the conversion of standard machine tools in order that they may accept punched teleprinter tape for automatic control.

Tooling will then resolve itself into the simplest of fixtures for the accurate location of the work and the provision of a punched tape which has been produced on teleprinter punch machines or telewriters from numerical data supplied by the Planning Office.

This approach will enable a large variety of two-dimensional milling work, complicated programme drilling to close limits, the production of turned parts and other machine shop operations to be carried out with a minimum of tooling, with unvarying accuracy.

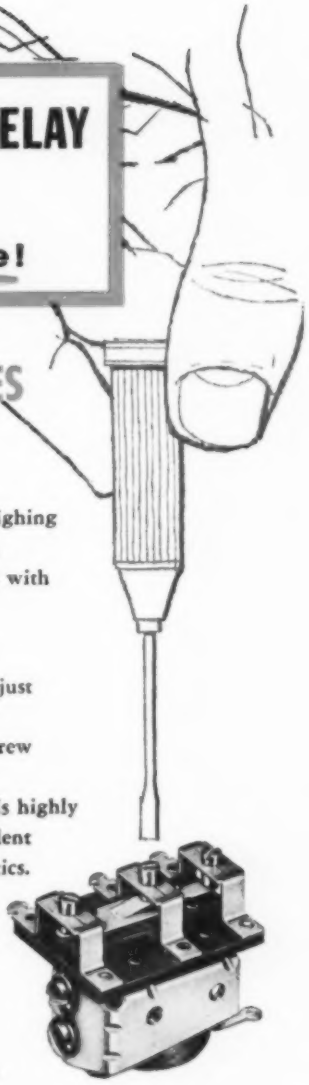
The introduction of this system will inevitably reduce the lead time in the manufacture of new prototype aircraft and will very materially assist in reducing costs and times in full scale production.

It is therefore of the highest importance that this interesting new technique should be pushed on as energetically as possible, as it would seem to make it possible for us to excel in this type of construction, which fits in so well with our type of training and engineering background.

The disturbing feature, however, is the attitude of the machine tool manu-

UNIQUE SENSITIVE RELAY

incredibly small, lightweight and adjustable!



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The Advance "SO" is set at the factory to operate on 10 milliwatts. User can adjust it down to 2 milliwatts, or any desired pick-up or drop-out, by means of fine screw contacts. A balanced armature provides extremely sensitive operation. The unit is highly efficient, ruggedly built, and offers excellent shock and vibration-resistant characteristics.

Contact arrangement is SPDT. Coil resistances: 4000, 6500 and 10,000 ohms. Life expectancy: 250,000 operations. Available in open types... dust-tight or hermetically sealed enclosures. Now in quantity production, Advance "SO" relays are priced amazingly low. Write for literature.

Coil Resistance	Pick Up Voltage	Pick Up Current	Drop Out Voltage	Drop Out Current	Max. Coil Voltage for Continuous Duty	Overtravel	Contact Gap
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6500	8.1 V	1.25 MA	3.9 V	.6 MA	140 V	.0015	.002/.003
10,000	10 V	1 MA	5 V	.5 MA	175 V	.0015	.002/.003

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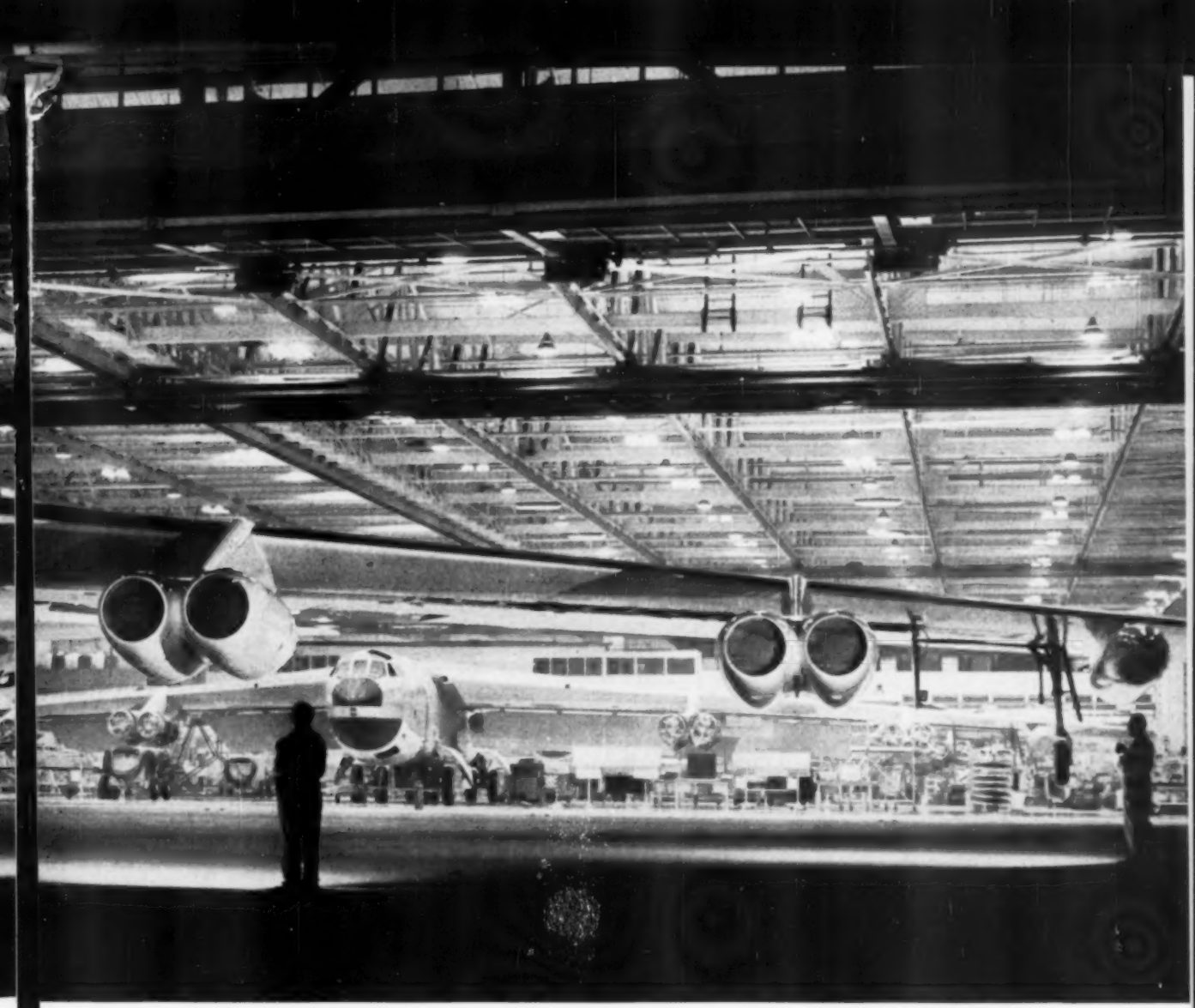

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facturers to this new conception. As far as I am aware they appear to be doing very little about it, and I understand that the research into numerical control which is going on in this country at the moment, is in the hands of firms other than machine tool makers.

Engine Future

Turning now to the future position of the aero engine industry in comparison with the considerable output required during the War, and also during the recent expansion on account of the Korean emergency, we are faced with relatively small production runs of large gas turbine engines. With the increase in complication of the larger turbines these small numbers, if made with the traditional elaborate tooling, would involve a very serious manufacturing problem. Therefore, the great need at the moment is for an increased flexibility of manufacturing methods, and the problems to be faced are in some ways akin to those which have unfolded on the airframe side.

Flexibility of machine tools in the production sense is only coming about slowly, but in our most modern aero engine plants today we are seeing, in increasing numbers, standard machine tools with control mechanism which enable the machine either to repeat settings or to follow a given contour.

For the most part these are horizontal and vertical borers, the latter with automatic tracing devices and jig mills. It is with regret that it has to be recorded that practically all these machines come from abroad. There is a considerable demand for this type of plant for a large variety of purposes.

Machine tools are also just beginning to come into aero engine plants which are controlled by means of a series of instructions prepared from a computer. Here, again, it must be admitted that we in Britain are not leading on these important types of machines, but they will undoubtedly play a large part in the new type of aero engine manufacture, when the control equipment has been fully developed.

It is generally accepted that automation in the varying categories of engine shops throughout industry applies chiefly to the large volume production of automobile power plant.

While the more spectacular and obvious applications will undoubtedly show to the best advantage in this class of high volume industry, there is still room for the development of items coming under the heading of automation in the batch production industries such as aero gas turbines.

The greater portion of production, however, in this country is on the batch principle, and it must not be forgotten that it is one of the most complex types of manufacturing.

Frequently examples are seen where the actual tooling and cutting equipment on the machine tool is first rate, but the manner in which the work is brought to the machine and loaded into the fixtures before the operation, then removed from the fixtures and taken away after the operation, seldom receives any consideration.

There is a great field for the application of automatic handling devices in this kind of batch production. This is going to tax the ingenuity of the automation engineer because the essential features of devices of this nature will be that in themselves they will require flexibility, as they will have to deal with successively difficult components.

Their cost therefore can only be justified if they can be used on a number of different jobs.

Inspection Changes

We are undoubtedly going to see important changes in inspection methods including electronic testing devices, as well as the further expansion of non-destructive testing, and some of these may prove to be the precursor of further automation.

Here, again, from a recent tour in Germany, I gather several of their firms are active in these directions.

It will therefore be seen that there is an important and exciting new field of production techniques for the comparatively small quantities of future air frames and aero engines, which we may expect to be coming along in the not too distant future, and instead of having to face unsupportable costs for extremely expensive tooling, we can anticipate the sort of production costs which are within our scope, and suit the type of production engineer and craftsman we have so successfully produced in the past.

It is therefore up to our managements to seize on to these opportunities and produce the right type of aircraft, and for our production engineers to collaborate with the electronic and machine tool industry, energetically and quickly.

It may well be that the aircraft people will have to design and develop their own machines, which I believe is already being done in certain instances. It is, however, no good talking about these innovations as far-off research possibilities; let us grasp with both hands this opportunity to employ the sort of engineering which has for so long been our birth-right.

There must be more development effort expended on production techniques both by the Government and industry. Up to the present we have spent little on development for production as compared with design.

When all is said and done, we come back to the bald fact that the nation's needs in aircraft are not being met today, mainly because we have not got sufficient of the right type of trained human beings to organize and control this extremely exacting but enthralling business of aircraft engineering, which embraces all forms of air defence and air transport.

In the final analysis therefore, as in nearly every other human problem, it is the man who counts more than anything else, and it is right here that our greatest hope lies, because we know we have the correct material in embryo, if only we have got the courage and clear-thinking to spot and bring on the talent which is already there lying dormant, and take steps promptly to train sufficient of the right type for the future.

Last year the press was flooded with articles and reports about Britain's shortage of engineers and technologists, and there were many schemes put forward as to how the matter was going to be tackled. At long last, therefore, the nation should be now aware of the sombre fact, which is as simple as this: that if this country is going to survive at all, as a great power, something must be done about training a greater number of first-class engineers and technologists of ability very quickly indeed.

Supply-Demand Gap

I have the uncomfortable feeling that comparatively little has yet been done about this matter beyond a great deal of talking, and I am not convinced that the "powers that be" are certain of the best way of tackling the problem.

Although quality is always more important than quantity, I still think we are light on our estimates on the number required. It is officially stated that the gap between supply and demand of engineering graduates is 25%; I suggest it is at least 33%, and may grow even more unless something is done about it promptly.

What the aircraft industry has to ensure is that it gets its share of the right type of those that are coming forward for training. We must be thankful that the aircraft industry is a good deal more enlightened on training than many other branches of engineering and that a number of firms have well established apprenticeship schemes and technical training departments.

But the aircraft industry is not doing enough, or going fast enough on training, and they are shorter of first-class production engineers probably more than any other category and have not yet, in my view, evolved an entirely satisfactory curriculum for training production engineers.

Let us consider for a moment how

aeronautical technicians and executives were provided in the past. A very small number indeed had the advantage of a university degree.

For the most part they came up the hard way; either by matriculation or later on by Higher National Certificate, or an apprenticeship with part-time work at a Technical College. In fact, one might say that most of them were amateurs, who had graduated by the light of day, hard work, earnest endeavour and common sense. Our production people, until a few years ago, were selected in an even more haphazard way, and were mostly from the shop floor.

Many of our most brilliant successes amongst design, development and production executives in the past were engineer enthusiasts, i.e. amateurs who had been recruited into these categories and had the great urge to go into this new line of engineering, were willing to work very hard and possessed courageous thought and leadership.

I think we are all agreed that the size and importance of the industry today, the tempo and complexity of modern supersonic aircraft and gas turbines, with all their many facets, demand a more highly developed individual to fill the leading posts in industry.

This is far too broad a subject to attempt to discuss in detail today, but here are a few suggestions on matters which will help the supply of more suitably trained graduate engineers:

Education Problems

Incidentally, while we are on the subject of training engineers, it would be a good thing if the terminology and definition of the different classes of engineers were once and for all settled, and if the U.S.A. and ourselves could come to an understanding on this matter it would be even better.

Starting at the very beginning, we must tackle the poor quality of basic education given to school children today. There is too much experimental work going on by crank psychologists, and what is wanted is sound rudimentary teaching without so many freak trimmings.

The failure of National Certificate students to meet the requirements in the higher supervisory categories in modern precision mechanical engineering has led to the expansion of sandwich courses, comprising alternate periods of up to six months, of full-time college attendance, combined with industrial training.

This scheme seems to be working out very well indeed, but wants considerable widening.

It would seem that there are a number of late developers with latent engineering ability who, if they were allowed to stay at school another year, might prove quite useful technicians; it is stated that there are anything up to 5,000 boys per annum in this category who, if they were allowed to stay at school until 18 could become an important asset, in order to help the present shortages.

I gather that of sixth-form Public and Grammar school boys, considerably less than 50% are taking mathematics and engineering as their advanced subjects, and a marked change must be made in this percentage if the number of outstanding engineers and technologists is materially to increase.

To fill immediate short-term gaps I suggest firms might devote more time to talent-spotting from their present ranks. I am of the opinion there is appreciable latent ability existing today which a small enthusiastic expert panel could discover and which would respond quickly to special courses.

An urgent need in the aircraft industry is obviously the training of a modicum of first quality production engineers. These should be men of ability with a good general engineering and technical background. At present I suggest this matter has not yet been tackled in a broad enough way, and a top grade production engineer needs a wider technical and practical background than most other branches of the engineering profession.

A Production Engineering faculty consists of much more than a small Machine Shop with a lecturer and one or two demonstrators.

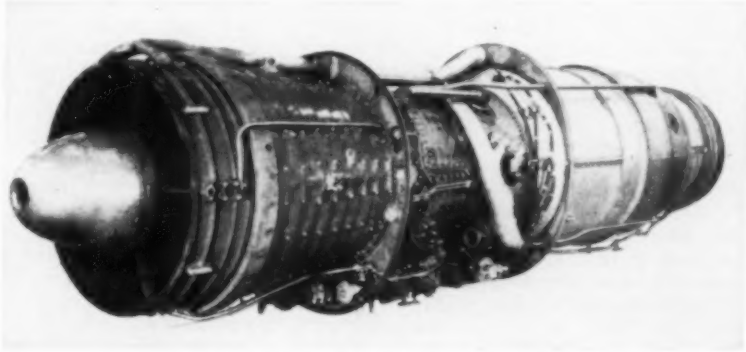
I would recommend those interested in the training of production engineers to study the report on "A Six Months' Observation of the American Methods of Training in Industrial Engineering and Management in the Universities and Industrial Plants" prepared by Mr. T. B. Worth, Head of the Production Engineering Department at the Central Technical College, Birmingham. This was undertaken at the request of the Ministry of Education, and shows the pattern of industrial engineering training given in a four years' course. It is interesting to note from this report, that the percentage increase of students in industrial engineering in the States between 1940 and 1950 is 376% as against 15% in mechanical engineering, and 168% in chemical engineering.

From a short study I made last summer of engineering training in the U.S.A., it would seem that America is about as far ahead of Britain in training production engineers and supervisors from the senior executive to the foreman, as we are ahead of America on apprenticeship and craftsman training for the mechanical trades.

It must be faced that there will be little improvement in the whole question of training engineers until the position of suitable engineering teachers has been corrected, both as regards status, numbers and salaries. This is a matter of prime importance, which can no longer be shelved, and is, I understand, a world wide problem today.

A new fund sponsored by 17 of the largest industrial concerns in the country and guaranteeing over $4.2 million to make suitable grants in engineering education is a step in the right direction, but it is highly important that by the time these grants have been put into practical effect, there is a sufficient supply of really first-class teachers and the right quality students. This shortage of good engineers, who are the very lifeblood of the aircraft industry, must be dealt with by giving sound advice to parents and teachers of the opportunities that the profession offers, and we must ensure that the opportunities are real, in every sense of the word, and not mythical.

In spite of all the difficulties and problems that undoubtedly exist and have to be solved in this country in order to get enough of the right type of



Bristol Olympus Eleven

Latest model of the Bristol Olympus, the BOL.11, has been approved for service at 12,000 lb. thrust after successful completion of its 150-hr. type test at that rating and is now in production. Engine is being built for RAF's Avro Vulcan bombers.

young man for aircraft engineering, I feel we shall not be successful unless there is an absolute about face of the whole nation, as to the importance of all branches of engineering, and particularly aircraft engineering, for the coming generation.

Let us be frank about this; it is still not "out of the top drawer" to be a mechanical engineer. The scholastic hierarchy from our senior schools and universities have for some long time accepted science, and now give lip service to engineering as an accepted profession, but by and large, still do not believe it to be so in their hearts. In actual fact, it is first-class engineers of high ability recruited from the right background that this country needs.

I was astounded, when I was working for Sir Stafford Cripps on the preliminary negotiations for the setting up of the College of Aeronautics, and had to visit a number of his colleagues on his behalf on this matter, how strongly these old traditions prevailed, even amongst many of the most eminent men in the Government of the time.

I, therefore, propose to devote the rest of my comments on education in an endeavour to help debunk these "dyed in the wool" fallacies.

Mr. George Constantinesco delivered a classic lecture on this subject before the Society of Engineers a few years ago, and I propose to quote a few of his comments:

"It is difficult to give comprehensive definitions to distinguish between the scientist and the engineer. Both of them use science, only in different ways.

"Early scientists like Plato and Aristotle had their own ideas about master and slave relations, which made them rather contemptuous towards the mechanical arts . . .

"What are called the mechanical arts carry a social stigma and are rightly dishonoured in our cities." That was a good shot by Xenophon against the engineers of his time (430-355 B.C.).

"This old cleavage between pure science, as scientists like to call their domain, and the practical science which by contrast is the domain of the engineer, exists to this day, only in a slightly modified way.

"To argue that engineering is the product of applied science is not correct. Engineering is the product of knowledge of all kinds of skill, perseverance, imagination, faith, sacrifice, fanaticism, invention, war against human toil, and unfortunately often war against the scientists.

"And why is it called the Science Museum? Why not Engineering Museum?

"The keynote of most of the exhibits in the Science Museum is the faith of inventors who used their knowledge and skill to illustrate and achieve something new in spite of the science and the scientists of their time.

"One fears that the reason is to be found in the old lingering tradition that practical science is inferior to pure science,that people who work with their hands are inferior . . .

Lingering Doctrine

"This is the doctrine that was alive at the time of Pythagoras, Plato and Aristotle. It is just as well to realize that this doctrine is not dead . . .

"Scientists are not superior to engineers. Scientists, engineers, pioneers, inventors and all, are but children of nature looking from different places and in different circumstances at the same problems.

"This barrier between scientists and engineers could be lifted by training both of them at the same school. A start has been made at the University of Durham to introduce humanities into the training of engineers.

"Eventually scientists and engineers should merge into one single qualification of men with one single purpose to work together . . ."

Commander G. Penn's recently published book entitled: "Up Funnel—Down Screw" brings out excellently the long fight the naval engineer has had to come into his own. The improvement in the status of the naval engineer has been comparatively slow.

It has taken about two normal lives since the Captain of H. M. S. Alban ordered his Chief Engineer to be flogged when he had trouble with his engine, to the time when it has been publicly stated that naval engineers are "all first and foremost naval officers." Only during the last few months has the naval engineer shed the "E" stigma, which has been with him for years.

For generations past the most promising British up-and-coming stock has been led to believe that by taking a classical education, they were equipping themselves most suitably for the most interesting and best paid professions, and that, by and large, these did not include engineering.

We can correct the many other anomalies that exist today and take the necessary steps to provide adequate facilities to train the right type of engineer for the Services, Government departments and industry; but one of the most important things to help on the production of our aircraft on a long-term basis is to eliminate this stigma on engineering as a profession.

What then are we going to do for the future to meet the urgent needs of the nation for aircraft? Sir Winston Churchill wrote in his account of the last War, that under such circumstances, the great thing to remember was the overall objective. Are we really quite clear what this is as applied to our particular problem? We certainly cannot afford to leave things as they stand today—10 years after the War.

It seems to me our main trouble has been that, with a few notable exceptions, neither in the Government nor in the British aircraft industry has it been realized the vast opportunities that would be available during these 10 post-war years. For the time being we have lost the courageous leadership and the burning spirit to succeed at all costs.

This failing is only symptomatic of where the country stands today in many other respects, and it would seem that after a civilization of as long standing as ours wins a major war, the tremendous effort that has been put out is followed by an impoverishment of initiative and fresh endeavor. This results in a whole crop of well-meaning but ill-considered regulations coming into force which are exploited and abused with disastrous results.

We must take a stand to prevent this weakness eclipsing a young and vital industry such as aviation, and everyone in Government service and industry, including the youngest of you present here today, all share in some measure the great responsibility that exists, to contribute towards putting this matter right with the least possible delay.

Let us, therefore, go back to work from this Conference realizing that everyone, however humble, can make some contribution, and that we must no longer accept excuses or words, but must be determined to have deeds.

As I was writing these notes, a few days ago, I received a copy of Lord Hives' Christmas message to his workpeople in which he said that he believed it is worth fighting hard to preserve his company's reputation in the coming year. Knowing they had the knowledge, the skill and the resources if they would preserve a spirit of goodwill and willingness to help others, he was confident for the future. This is the spirit which wins out! It is our very lifeblood for British aviation to fight hard.

Some firms however, are better situated in regard to leadership and knowledge than others, but by and large, I believe the potential resources are all available in this country to meet our needs in aircraft, if only everyone will courageously "put their shoulder to the wheel" and not let up. So far, however, in my view we have hardly made the first move on the fundamental issues.

(This is the fourth and last in a series of articles in which Aviation Week reprinted the speech by Sir Roy Fedden before Britain's fourth Conference on Problems of Aircraft Production. Sir Roy has served on three occasions as president of the Aeronautical Society.)

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New Device Boosts Computer Flexibility

A new device which generates a dependent variable signal as a function of two independent variables, making it extremely useful for analog computers, flight simulators and aircraft trainers, has been developed by the Stephen-Douglas Co. under Wright Air Development Center sponsorship. Expressed mathematically, the device develops a signal $Z = f(X,Y)$.

Called PHOSIAC (Photographically Stored Information, Analog Comparator), the new equipment permits rapid change of the functions generated. This is done by merely changing a small photo plate upon which the data is stored.

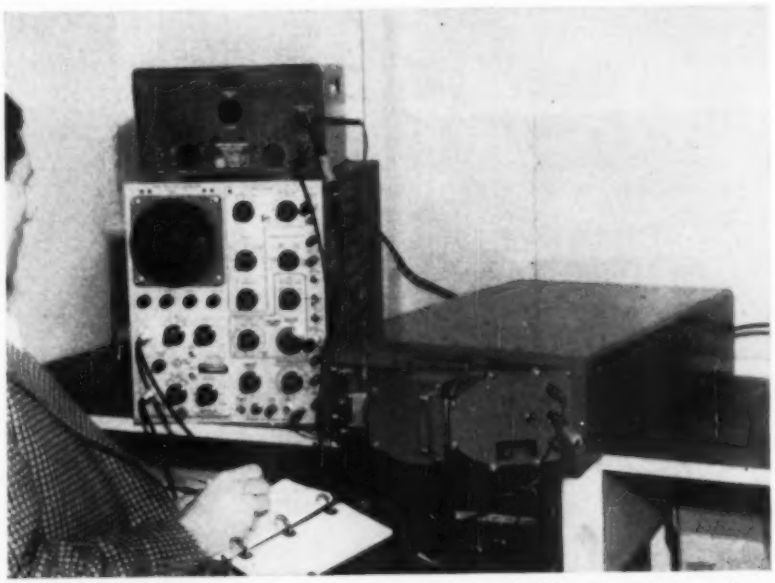
Function generators, widely used in flight simulators, are two-dimension (function) devices, consisting of a servo-driven potentiometer, wound to duplicate the characteristics of one specific curve. If it is desired to simulate a family of curves (three-function), it is necessary to stack a number of such potentiometers, and provide a switching device to shift from one to another, Stephen-Douglas says. And if it later proves necessary to change the form of the equation described by the family of curves, in the event of a change in basic airframe characteristics, the potentiometers must be replaced or reworked.

PHOSIAC can perform the three-dimensional function, without switching, with a frequency response of 100 cps. or higher, considerably beyond that obtainable with potentiometers, Stephen-Douglas says.

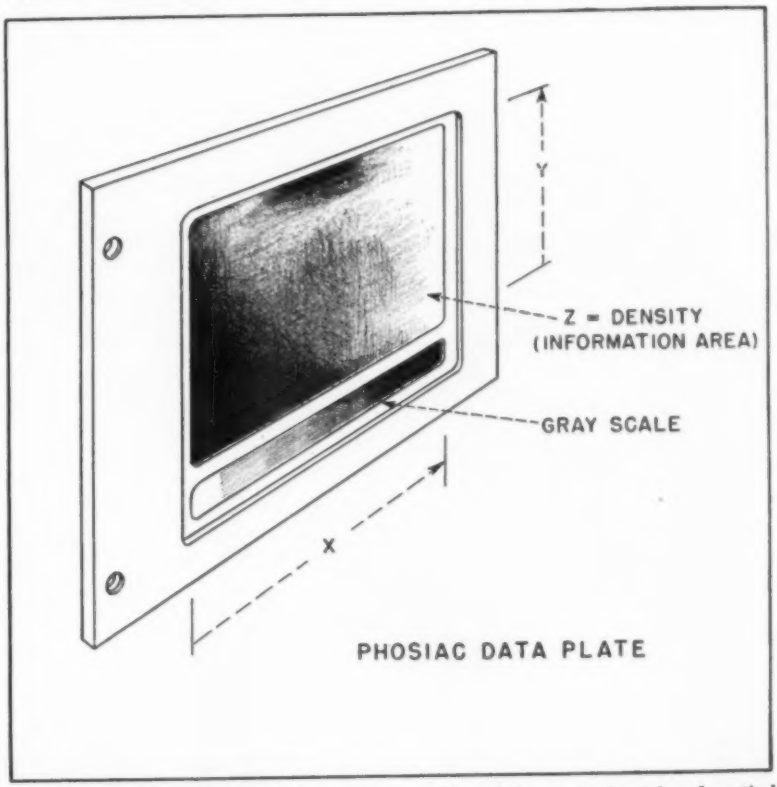
The data plate used in PHOSIAC is prepared from a family of curves which describe the desired function. The data is first converted to punched tape, which in turn controls the exposure of various portions of a 5x5-in. film, which in turn is reduced to 1½x1½ in. to form the data plate.

The density (darkness or lightness) of the film at any position relative to its "X" and "Y" direction coordinates represents the value of the variable "Z" as a function of the two independent variables "X" and "Y" on the family of curves.

The data plate is inserted in PHOSIAC between a dual beam cathode ray tube and a photo-multiplier tube. One beam of the CRT is positioned in an "X" and "Y" direction by two deflection voltages, each proportional to the desired value of the independent variables. The amount of light which passes from the CRT through the data



PHOSIAC ACCESSORY (right) for analog computers and flight simulators generates a signal as a function of two independent variable inputs. Key to PHOSIAC is the . . .



DATA PLATE in which film darkness at any point, relative to horizontal and vertical axes, represents value of variable function. Bottom gray scale provides calibration.

how North American Aviation
solved a tough metal forming problem

The jet engine on North American Aviation's F-100D Super Sabre gulps up to 2500 cu. ft. of air each minute. To minimize the disturbance of this high speed air flow, the jet engine accessory cover must be of precise shape to conform with the efficiency of duct design. After evaluating bids from suppliers on the basis of reliability, delivery, performance and cost, North American Aviation chose Pastushin's bulge forming process for this exacting metal forming task.

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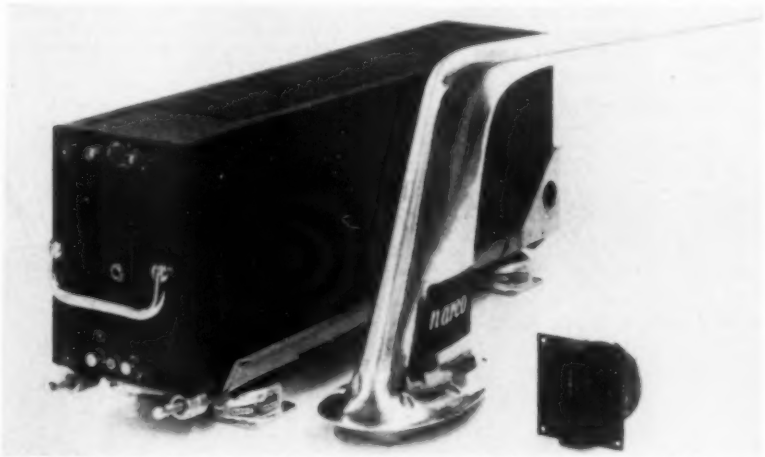
plate to the multiplier tube is then proportional to the desired dependent variable. The multiplier tube generates a proportional output signal.

To compensate for variations in CRT intensity, as well as changes in the density of the data plate caused by temperature or other factors, each data plate has a graduated "gray scale" along the bottom, which is affected by the same factors.

The second beam of the CRT focuses on this reference scale and serves in effect to calibrate the primary density measurement, canceling out the above source of error.

The device will accept input voltages (independent variables) of 0 to 50 v., and produce output voltages of 0 to 400 v. Accuracy is quoted at 2% of full scale or better, and response time is 0.01 to 0.02 seconds.

Stephen-Douglas Co.'s address: 2950 Nebraska Ave., Santa Monica, Calif.



NARCO'S NEW and small combination VHF communications receiver-transmitter.

Communications Set Cuts Weight by Half

A new small combination VHF communications receiver-transmitter, with 5 kc. spacing, which is approximately half the size of comparable equipments now on the market, has been made available by National Aeronautical Corp. The new Model 1016, second member of Narco's deluxe "Sapphire" line, provides a VHF transmitter with a choice of 90 or 360 channels, and a VHF receiver with 90, 360, or 560 channels, covering the 108 mc. or 118 mc. to 136 mc. band.

Narco reports that the new 1016, which weighs less than 25 lb. and comes in a ½ ATR case, is the first set available to meet new, more rigorous requirements established by the Civil Aeronautics Administration.

The basic 1016 transmitter and receiver provide 90 channel capacity. However, by adding 19 more crystals, the transmitter capacity can be increased to 360 channels, while the receiver can be increased to 360 or 560 channels by using up to 48 crystals.

When used for "simplex" operation (transmission and reception on the same frequency), a single-channel selector in the cockpit instrument panel automatically tunes both the transmitter and receiver. If cross-band communication is desired (transmit and receive on separate frequencies), separate frequency selectors can be mounted side by side.

The Sapphire 1016 is designed also to provide VOR and ILS localizer functions when a companion unit, now under development at Narco, is added. Like the Narco DME, the new 1016 has been designed with modular construction. The transmitter, receiver, and power supply can be quickly removed for repair or replacement, Narco says. The firm also is marketing a broadband antenna for use with the set.

The Sapphire 1016 is priced at $2,490 for the basic 90-channel unit, or at $2,900 for the set with 360 transmitter channels and 560 receiver channels. Narco's address is Ambler, Penna.

Expansions, Changes In Avionics Industry

International Business Machines Corp. will establish data processing centers in Los Angeles, Calif., Portland, Ore., and Seattle, Wash., as part of a multi-million dollar expansion of its West Coast operations. The centers' facilities will be available to industry on a rental basis. The Los Angeles data processing center, to be housed in a new 13-story building slated for occupation in mid-1957, will be

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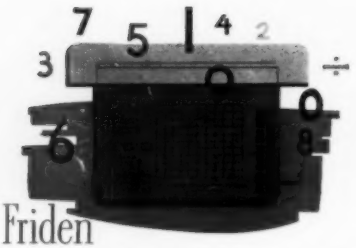
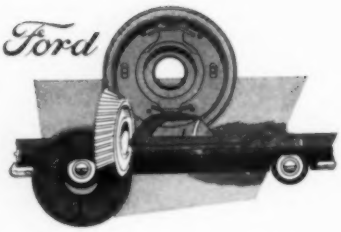
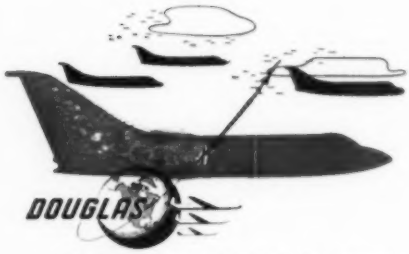


Friden Calculating Machine Co., Inc. has many production as well as research uses for -hp- counters. These include matching relay closing times, checking electrical stability, determining electrical requirements of experimental circuits and testing pilot and production models.

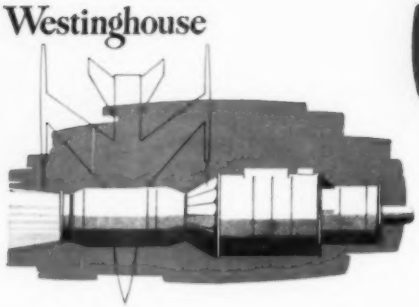


Ford's Engineering Research Laboratory at Dearborn finds -hp- counters a new, fast way to study automatic transmission performance, time braking action, measure engine cylinder volume and study valve train dynamics.



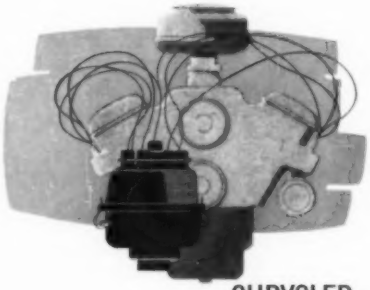
Douglas uses -hp- Counters for time interval work, (measuring time segments as small as 1/100th second) as well as for frequency measurement on AC inverters and generators and determining frequency characteristics of transformers.

IBM quality control relies on -hp- Counters to check split-second operating times in electric typewriters and similar mechanisms. Counters help insure uniform type impressions.



At Westinghouse, the same versatile -hp- counters that measure turbo-jet rpm's also check adjustment of precision circuitry in new color television receivers and perform many other useful measuring jobs daily.

General Electric uses -hp- Counters in both development and production measurements. Typical uses include checking watthour-meter performance and checking crystal frequencies for keying G-E color and monochrome TV receivers.



CHRYSLER

Chrysler products must prove themselves before an impressive array of test devices. -hp- Counters measure revolutions and evaluate performance of moving parts with extreme accuracy —even timing actions occurring over intervals as small as 1/100,000 second.

Electronic Counters are one of many electronic test instruments ready to give you better engineering and manufacturing—*today!*

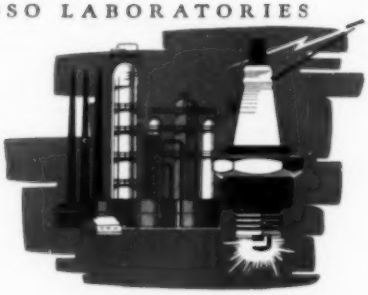
These Counters are not delicate, expensive prima donnas requiring a staff of PhD's to operate and maintain. About the size of a large table radio, they're rugged, dependable, job-proven, versatile, manufactured in quantity and priced from about $900. Anyone who can count can use them—they require no charts or complex calculation. Yet their performance is perfection itself—direct-reading, instantaneous, automatic; accurate within 1 part per 1,000,000.

Industry uses Electronic Counters to measure rpm and rps, weight, pressure, temperature, velocity, speed, acceleration, slippage, elapsed time or time intervals, frequency rates, production quantities. And, they have many other functions; Electronic Counters are only at the threshold of their usefulness to industry.

Electronic Counters

new way to better engineering

ESSO LABORATORIES



Standard Oil Development Company's Esso Research Center uses -hp- counters to reveal gasoline performance by quickly, easily measuring engine speed vs. torque, time lapse between "spark" and explosion, time required for maximum thrust after firing.

Hewlett-Packard is a world leader in Electronic Counters, as well as other major electronic measuring instruments. The *-hp-* line includes over 250 different equipments—providing almost complete coverage of measurements that can be made electronically.

Over 100 *-hp-* field engineers serve manufacturers throughout the United States and overseas. Their first job is to give you the right answers about applicability of electronic instruments to your operation. Their second is to recommend and help apply the correct equipment. If you'd like to explore this idea in more detail, please write us. The *-hp-* engineer in your city will reply promptly.

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equipped with IBM's new 704 and 705 computers, as well as smaller electronic calculators. The Portland and Seattle centers, to be equipped with IBM's 650 magnetic drum processing machine, are expected to be in operation by mid-year.

The company also will build a 400,000-sq. ft. data processing machine manufacturing, engineering, and education facility at San Jose, Calif. IBM also says that it will build a 400,000-sq. ft. manufacturing facility at Rochester, Minn., for occupancy by 1958.

Other recently announced expansions and changes in the avionics industry include the following:

• **Texas Instruments Inc.**, Dallas, has purchased the business and assets of the Burlington Instrument Co., Burlington, Iowa, maker of electric indicating instruments. The new acquisition will be transferred to Dallas and integrated with TI's Components Division as soon as possible, without interrupting deliveries to present Burlington customers.

• **United States Time Corp.**, New York, has signed a research and development agreement whereby Electronic Specialty Co., Los Angeles, will carry out special research assignments in the electronics field. U. S. Time Corp. also takes a one-year option on all presently authorized but unissued shares of Electronic Specialty Co.

• **Olympic Radio & Television, Inc.**, New York, has purchased all outstanding stock of David Bogen Co., New York, maker of hi-fi and communications equipment. The purchase is called "the initial step in Olympic's over-all plan of expansion and diversification."

• **Collins Radio Co.** has opened a Seattle sales office, to serve Northwest area, at the White Henry Stuart Bldg., 1318 Fourth Ave. C. L. Pfeiffer is office manager.

Movable Computer

Desk-size digital computer, general-purpose, Model LGP-30, has magnetic drum storage capacity of 4,096 31-bit words, with access time of 17 milliseconds maximum. The computer can be moved on wheels, operates from 115 v., 60 cps. power, and requires no air conditioning or special installation. Price is $29,800. Librascope, Inc., Glendale, Calif.

FILTER CENTER

▶ **Who's Scared of Tacan?**—Narco reports that an "upsurge in orders" for its DME equipment has created a 60-day delivery backlog. Narco, which recently delivered its 230th DME, has put its entire production force on a six-day week, while its test department has jumped from a 40 to 60-hour week to step up output.

▶ **Collins Integrated Package**—Collins Radio Co. is developing a new integrated CNI (communication-navigation-identification) package for the McDonnell F4H. The new CNI package, which employs modularized construction throughout, will include the basic elements of the ARC-52 UHF transceiver, ARA-25 UHF direction-finder, ARN-21 (XN-10) Tacan receiver, and IFF. Several other airframe manufacturers, including Air Force suppliers, are reportedly interested in the Collins CNI package.

▶ **Neat Trick**—Air Force has a requirement for a new type of radio communications system which should not be susceptible to enemy detection or interference. Anybody got any ideas?

▶ **AIEE Meeting**—"Electricity in Aircraft" will be the theme of the three-day Southwest district meeting of the American Institute of Electrical Engineers, at the Baker Hotel, Dallas, Apr. 2-4. Among the 30 technical papers scheduled for delivery are the following:

- "A New Solution to the Aircraft Boresighting Problem," C. W. Clements, Convair.
- "Integrated Electronic Systems for Aircraft," Robert Olson, Collins Radio Co.
- "Integration of D.C. Power Supplies for Airborne Electronic Equipment," J. M. Murphy and H. D. Stevens, Convair.
- "An Automatic A. C. Generating System for Aircraft," L. R. Oman, Boeing Airplane Co.

▶ **Volscan Tests Soon**—Evaluation tests on a new production prototype of USAF's Volscan return-to-base computer are slated to begin around June at the Clinton County (Ohio) airport. The new unit, built by Crosley Div. of Avco, will have several innovations, including the ability to compute a reduced-radius turn-on path for prop-driven aircraft, with a wider radius turn-on farther out for jets. Unit will also give automatic warning of possible altitude conflict between aircraft, with indicating lights to show the speed of each aircraft under control.

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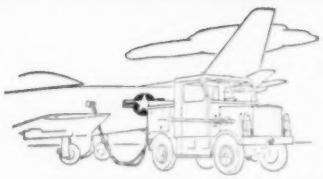
GROUND SUPPORT !



To meet the vital jet age needs of ground support, Consolidated has devoted its fullest resources developing both single and multi-purpose units . proven efficient . and now in active service. Typical of these units is the Consolidated Model 2001 (U.S.A.F. MA-1). This highly compact self-propelled vehicle combines in a single unit all requirements for towing, testing, servicing and starting jet aircraft.

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- **A. C. POWER . . . 30 KVA, 400 cycles, 3 phase and 10 KW 1 phase, close regulated.**
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- **COMPRESSOR . . . Air supply up to 3500 psi, 13.5 CFM, 1,000 cu. in. reservoir.**
- **TOWING . . . All-wheel drive vehicle with mechanical or torque converter transmission, as desired.**

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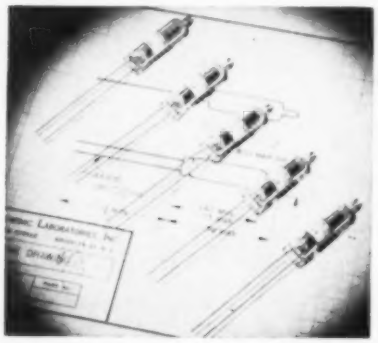
NEW AVIONIC PRODUCTS

Components & Devices

• **Voltage regulator tubes,** miniature and subminiature, fixed and adjustable corona types, for stabilizing voltages from 300 to 30,000 volts at currents below several milliamperes, are available with voltage tolerances of plus or minus 1%, when required. Tubes are designed for operation between tem-



peratures of −55C and 75C. Regulated voltage value of tubes operating below 4,000 volts changes about 1% through this temperature range, while tubes operating above 4,000 volts have less change, manufacturer says. Anton Electronic Laboratories, Inc., 1226 Flushing Ave., Brooklyn 37, N. Y.

• **Test jack for printed circuit boards** measures only ¼ in. dia. x ¼ in. long. Device is made of brass, plated with gold over silver to provide low contact

resistance and prevent silver migration in printed circuits. Grayhill Co., 561 Hillgrove Ave., LaGrange, Ill.

• **Precision single-turn potentiometer,** designed to permit simplified external phasing of multi-section gangs of pots, is available in five different diameters, ranging from ⅞ in. to 3 in. Phasing is accomplished by loosening clamping nut, moving terminal board, then retightening. Bulletin 754295 gives full data. Clarostat Manufacturing Co., Inc., Dover, N. H.

• **Subminiature selenium rectifier,** Type 60-9267, for use with d.c. relay coils operated from a.c. is a full-wave rectifier with center tap, permitting its use

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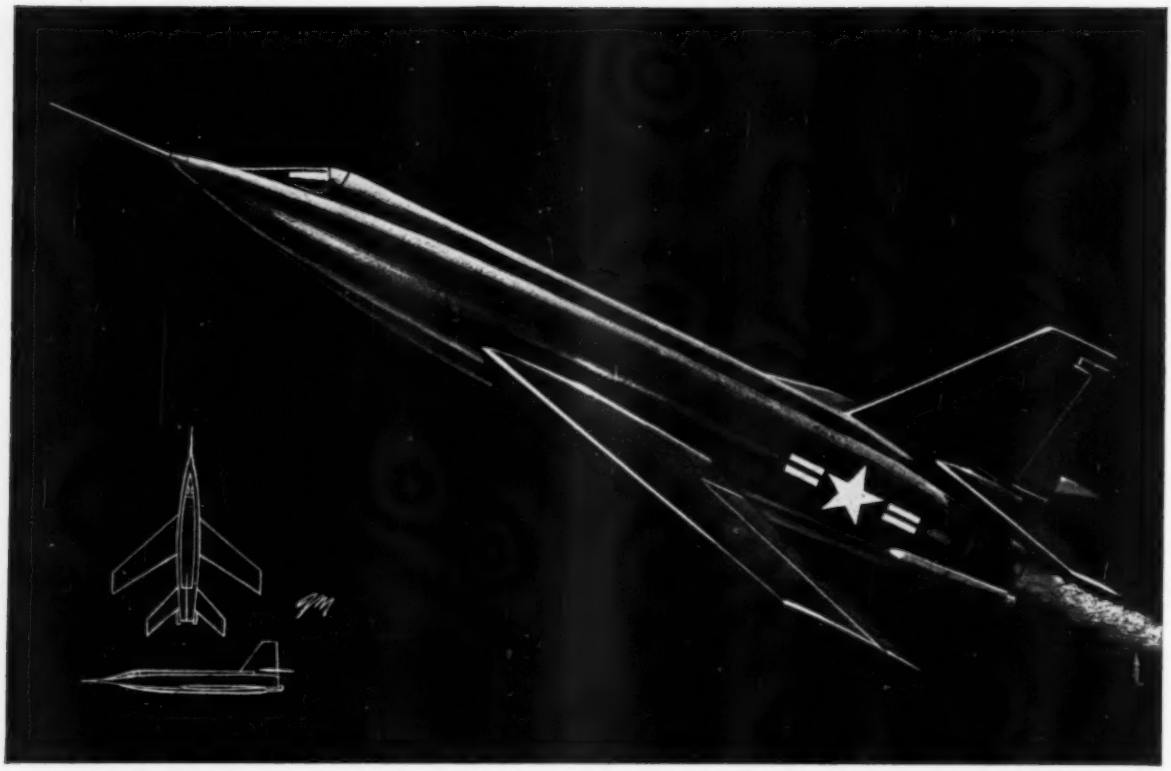

The Bell X-2's huge power comes from a throttle-controlled Curtis-Wright rocket engine built by that company's Propeller Division, Caldwell, N. J. This research plane was built at Bell Aircraft Company's Buffalo, N. Y., plant. Wings and fuselage are of nickel-containing alloys — to withstand very high skin temperatures.

To explore the Heat Problem at supersonic speeds

This rocket-powered research plane, the Air Force's Bell X-2, is built to fly at high Mach speeds.

As she tries for new speed records, tremendous heat caused by air friction will test her materials at temperatures higher than conventional materials can withstand. So her fuselage skin is made of "K" Monel age-hardenable nickel-copper alloy — wings of chromium-nickel stainless steel — to *stay* strong at high temperatures.

The Bell X-2, like most high speed aircraft, relies on Inco Nickel and Inco Nickel Alloys for the unusual combinations of heat resistance, corrosion resistance, strength and ductility so necessary to safe and satisfactory performance. The Curtiss-Wright throttle-controlled rocket engine which powers the Bell X-2 depends upon Nickel, too, as an alloying element in many of its critical parts.

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Rocket engine rotors

Nimonic alloys
Combustion liners
Transition sections
Vaporizer tubes
Turbine blades
Rotor discs

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Tail cones
Afterburners

Incoloy "T"
Transition sections

Monel
Lock wire
Fine fuel line tubing
Rivets

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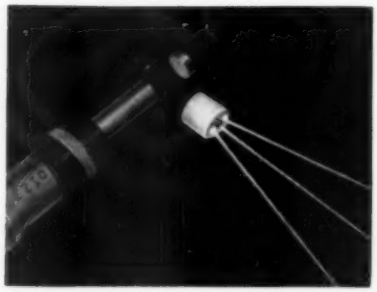
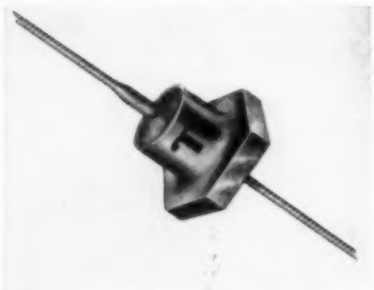


as a full-wave rectifier or as a half-wave and back-wave rectifier combination. Unit is rated for 66 v. maximum a.c. input, delivers 22 ma. d.c. as full-wave rectifier, and operates over temperature range of −50C to 100C. Device measures only 0.38 in. dia. x 0.38 long, and comes with pigtail leads. Bulletin SR-124 gives application data. International Rectifier Corp., El Segundo, Calif.

• **Axial-lead silicon rectifier,** suitable for installation on printed circuit boards, is now available with peak inverse voltage ratings to 600 v., and maximum average forward currents to



500 ma. at 100C. Unit occupies less than ¼ cu. in. volume. Bulletin TE-1335 gives application data. Transitron Electronic Corp., Melrose 76, Mass.

• **Delay lines,** specifically designed for use with printed circuit boards, are available to customer's requirements in small rectangular or tubular housings, with leads brought out at any angle or in any position. Units are moisture and fungus resistant and can be operated at temperatures of −55C to 125C. Manufacturer's catalog describes delay lines available as standard or custom-built units. ESC Corp., 534 Bergen Blvd., Palisades Park, N. J.

• **Hydrogen thyratron,** Type PL-161, for pulse modulator use, is 25% smaller than its predecessor. Peak plate voltage is 16 kv., peak plate current is 325 amp. New tube measures 6¼ in. high, 2¼ in. dia. Penta Laboratories, Inc., Santa Barbara, Calif.

• **Angular mil/nautical mile counter,** Model 1864, contains four digital

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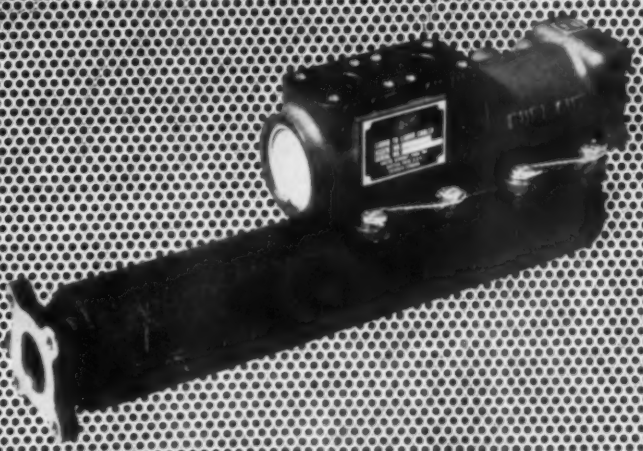

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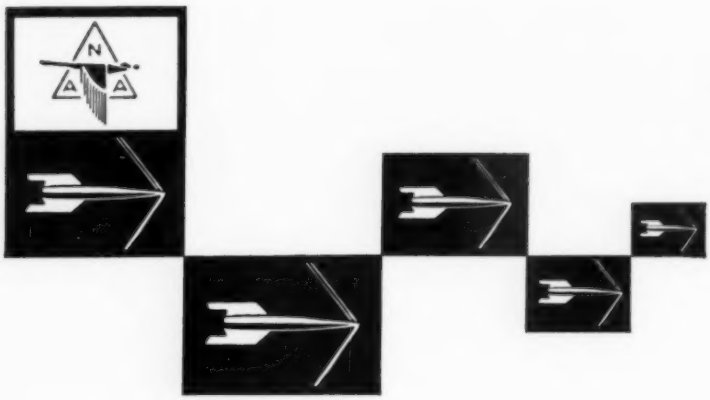

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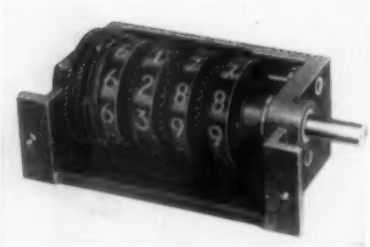


drums which provide 10 counts for each revolution of the input shaft, up to a count of 6,399 after which unit returns to zero. The counter is reversible at any point in its cycle, and can be operated at 1,800 rpm.

Lab Power Supplies

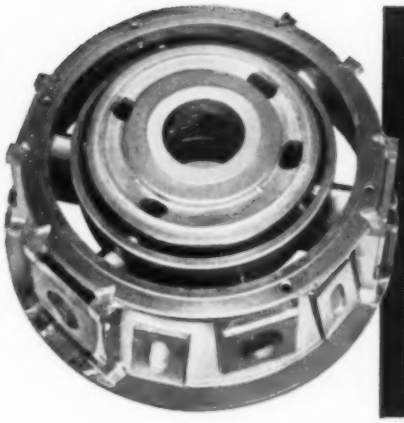
• **Microwave tube power source,** with isolation from ground on both sides of high voltage circuit, has continuously variable output of 0 to 7,500 volts at 500 ma. Larger capacity units of similar design are available up to 50 kv. Unit operates from 230 v., three-phase, 60 cps. source. Levinthal Electronic Products, Inc., 2727 Fair Oaks Ave., Redwood City, Calif.

• **Portable high voltage,** Models 207, 208 and 209, can provide up to 30 kv. at 5 ma. continuous, or 7 ma. below 25 kv. Output voltage is continuously

variable. Power supply can be supplied with ripple of 0.1%, 0.01% or 0.001%. Unit operates from 115 v., 60 cps., single phase. Beta Electric Corp., 333 E. 103 St., New York 20, N. Y.

• **Precision frequency,** Type 120A, provides 60 cycle power whose frequency is maintained to within 0.01% over temperature range of 0 to 75C. Unit provides continuously adjustable output of 0 to 135 v., and operates from 115 v., 50 to 400 cps. external power. A-V Manufacturing Corp., Field Engineering Div., 100 Indiana Av., N.W., Washington 1, D. C.

• **Power supply,** 14/28 v. d.c., regulated, is capable of supplying 200/100 amp., reportedly holds output voltage



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- CORROSION RESISTANT
- HIGH FATIGUE RESISTANCE
- HIGH ABRASION RESISTANCE
- PREFORMED CONSTRUCTION

Eliminates Instrument Interference!

• Just as we expected, many aircraft designers were interested in the recent announcement of our new non-magnetic aircraft cable. If you did not see it, "NO-MAG" has these characteristics:

NON-MAGNETIC PROPERTIES . . . "NO-MAG" cable is made from type 305 stainless steel. It remains non-magnetic after severe cold working —in contrast to standard stainless steel aircraft cable which shows a pronounced increase in magnetism after swaging, wire drawing or similar operations.

This non-magnetic property of "NO-MAG" cable eliminates instrument interference from cable magnetism.

CORROSION RESISTANCE . . . New "NO-MAG" cables have corrosion-resistant qualities similar to, but slightly better than, cables made of standard stainless steel.

GOOD THERMAL CHARACTERISTICS... The thermal expansion characteristics of new "NO-MAG" cable are much closer than those of standard stainless steel or carbon steel cables to the characteristics of aluminum alloys used in aircraft. This greatly simplifies maintaining cable tension under various changes in temperature.

HIGH FATIGUE RESISTANCE . . . Preformed construction and careful processing give new "NO-MAG" cable high fatigue resistance.

HIGH ABRASION RESISTANCE . . . New "NO-MAG" cable shows greater abrasion resistance than standard stainless steel aircraft cables.

TENSILE STRENGTH, while lower than that of stainless and carbon steel, is sufficient to enable replacing these, size for size, with "NO-MAG" on many applications where the characteristics of "NO-MAG" are required.

USE WITH SWAGED TERMINALS . . . Swaged terminals can be applied to standard AN dimensions.

COMPLETE RANGE OF SIZES, CONSTRUCTIONS . . . New "NO-MAG" is furnished in sizes from 1/16" to 1" in all of the standard aircraft cable constructions.

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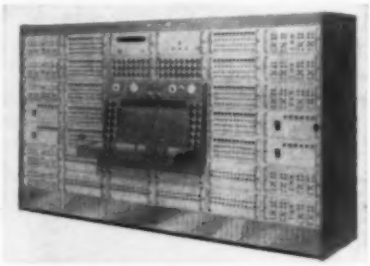
Aircraft Cable • Swaged Fittings

constant from no load to full load within 0.5 v., including 10% variation of input voltage. Unit operates from 220/440 v., 50-60 cps., three phase. Booklet H-1 gives application data. Rapid Electric Co., 2881 Middletown Road, New York 61, N. Y.

• **Aircraft battery substitute** provides continuously adjustable output of 0 to 30 v. d.c., with ripple held to 1% at maximum rated load current of 10 amp. Model KM81 operates from 115 v. a.c., 60 cps., single phase input. Opad Electric Co., 69 Murray St., New York 7, N. Y.

Computers & Data Processing

• **Geda analog computer,** Model A14, provides up to 96 operational amplifiers and 50 or more non-linear elements, which can be used as one large computer or two independent smaller units. Non-linear elements available include: high accuracy electronic multipliers,



precision electronic resolvers, stabilized electronic map readers for functions of two variables, and variable delay transport-lag simulators. Built-in problem analyzer checks wiring and accuracy of coefficients both during and after computer is set up, manufacturer says. Goodyear Aircraft Corp., Sales Dept., Akron 15, Ohio.

New Avionic Bulletins

• **Transducers** in a variety of types are described in several new bulletins (bulletin numbers are shown in parentheses). Force-displacement transducers (G1, G7A); pressure transducers (MPT-134, P60); inductive liquid rotor angular accelerometers (AA 3-1); unbonded strain gage liquid rotor angular accelerometer (AA3-A). Write to Statham Laboratories, Inc., 12401 West Olympic Blvd., Los Angeles 64, Calif.

• **Miniature connectors** for instrument use, including both resilient insert and hermetic seal types, are described in bulletin available from Deutsch Co., 7000 Avalon Blvd., Los Angeles 3, Calif.

• **Broadband cavity wavemeters** in 11 sizes, covering the frequency range of 2.6 to 90 kmc., are described in 4-page folder. De-Mornay-Bonardi, 780 S. Arroyo Parkway, Pasadena, Calif.

• **Contact modulator (chopper)** theory of operation and application techniques are contained in 16-page Bulletin No. 103. Write on company stationery. Airpax Products Co., Middle River, Baltimore 20, Md.

ALL AMERICAN SAFETY BARRIERS

will provide

safer jet aircraft operation

This jet-propelled car impels dead loads at aircraft speeds and landing weights into the safety barrier under test.

Overshooting or brake failure on landing—aborted takeoffs . . . these can mean disaster to today's aircraft. Tomorrow's heavier, speedier jet transports can run out of runways even faster.

All American Engineering Company can provide an Airport Safety Barrier to slow the heaviest transport from near flying speed to a dead halt in seconds—without injury to passengers and crew, without structural damage to the plane.

Long-time pioneers in arresting gear development, All American Engineering has extensive proving grounds for testing any application of the arresting gear or barrier for both military and commercial requirements.

In operation, All American safety barriers are equivalent to thousands of feet of extra runway—at a small fraction of their cost. They could open up existing airfields to the larger, faster landing planes to come—they could mean greater aircraft payloads as more runway can be used for actual takeoff.

All American is prepared to design a barrier to suit your specific requirements.

Tests with dynamic scale models—like the jet fighter shown here—complement the tests pitting actual aircraft against full scale barricades.

Unmanned jet aircraft about to be hurled along a 5000 ft. acceleration ramp into the safety barrier.

An advanced variant of the safety barrier is shown here under test—an electronically triggered arresting gear pops up to ease "hot" aircraft to a rapid halt.

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that became real serviceable aircraft — the CF-100,
the Jetliner and now nearing production,
the new secret supersonic interceptor — all this
in the short dramatic period of ten years.
The research, engineering and production
resources of Avro Aircraft form the nucleus of
Canada's newest industrial facility that has proved
it has successfully met the exacting time schedule
of the Jet Age and is now at work meeting, with reality,
the supersonic demands of tomorrow.

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1945—10 YEARS OF JETPOWERED AERONAUTICAL DEVELOPMENT FOR CANADA—1955

After the Great Ford Foundation Gift . . .

What Still Remains To Be Done To Provide Decent Faculty Pay

The Ford Foundation's gift of a half billion dollars to our privately supported colleges, medical schools and hospitals, now being distributed, is magnificent. But it will be much more magnificent if it inspires completion of the job to which it gives a lift. So far as the colleges and universities are concerned, this job is primarily to rescue their faculty members from being second-class citizens economically.

Even in a period when we have become accustomed to astronomical financial figures, a half billion dollars remains an eye-popping gift. In fact, it is so imposing that a good many people who don't read the fine print are apt to conclude that it must just about solve the financial problem to which it is addressed.

Goes Only a Small Way

However, we have allowed college professors to fall so far behind the parade financially that the share of the Ford half billion dollar gift going directly to the improvement of faculty salaries ($210 million) will go only a small way financially toward doing what is necessary to provide adequate salaries.

Completion of this job for our privately supported colleges and universities calls for:

1. An increase in faculty salaries at least five times as great as that made possible by the Ford gift merely to restore salaries to their 1939 purchasing power level and an increase fifteen times as great to provide adequate salaries today.

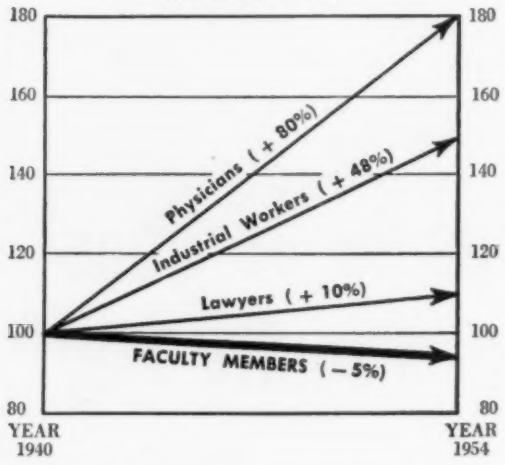
2. Some difficult and courageous decisions by the heads of the colleges and universities in apportioning the grants received by them.

Terms of Gifts to Colleges

The $210 million of the Ford Foundation gift going specifically to improve faculty salaries is being distributed on the following basis: Each of 615 privately supported, regionally accredited liberal arts and science colleges and universities receives a gift about equivalent to its last year's teaching payroll. For ten years only the income from these gifts is to be devoted to raising faculty salaries. After that all the money can be spent in any way the institutions receiving it see fit. There is no requirement that universities having other than liberal arts and science schools limit use of the gifts to improving salaries in these schools alone. They can spread it right through all their faculties if they wish.

In addition to the gift of $210 million specifically directed to increasing faculty salaries, another gift of $50 million goes to a group of 126 institutions selected for specially noteworthy leadership in improving

What's Happened to College Faculty Salaries*



* Real Income before Taxes.

Source: Council for Financial Aid to Education; U. S. Dep't of Commerce; U. S. Dep't of Labor.

the status and pay of teachers. For these schools the individual gifts add about 50% more to the amounts coming from the $210 million fund. They can be used to improve faculty salaries if the institutions choose to do so, but this is not required by the terms of these gifts.

The $210 million plus the $50 million should yield an income of $10-$13 million a year. Even if all this is used to raise salaries, it will be only a small step, however worthy, toward the $200 million per year the colleges need to meet their salary requirements adequately.

Helps Some Who Need It Most

In focussing its gift to improve faculty salaries in privately supported liberal arts and science colleges, the Ford Foundation aims at least part of the help at the spot where it is most desperately needed. Numerous surveys have indicated that the most poorly paid of all college and university faculty members are those in small, privately endowed liberal arts colleges.

But the overshadowing fact is that the teachers in our colleges and universities as a whole are badly underpaid. Just how badly is indicated by the chart above which first appeared in an earlier editorial. (Figures later than those for 1954 are not available.)

The Ford gift will turn the indicator of faculty salaries, which now lies far below the general salary trend, upward a few points. And it will do this in some places where salaries are below the wretched average shown by the chart.

But the Crucial Test Remains

College and university administrators will have the opportunity to extend further the process of getting the help provided by the Ford Foundation gifts where it is most needed. In general, this will mean giving it to senior faculty members, in order to hold experienced teachers and make college teaching attractive as a career. But to make such a division in many schools will take extraordinary fortitude.

The crucial test of the success of the enterprise of the Ford Foundation in raising faculty salaries will lie in whether it prompts the rest of us — college alumni, individuals, business firms and legislators alike — to see that it is a great beginning, not a signal for a recess.

Even with the Ford gifts providing $10-13 million a year, our privately supported colleges and universities must have an increase of about $190 million a year to provide decent faculty salaries.

This is a job far beyond the capacity of the Ford Foundation, imposing though that is. It is a job far beyond the capacities of a few hundred large corporations and a few thousand wealthy individuals. If it is to be done, it is a job at which all of us must work with a will.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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PRESIDENT

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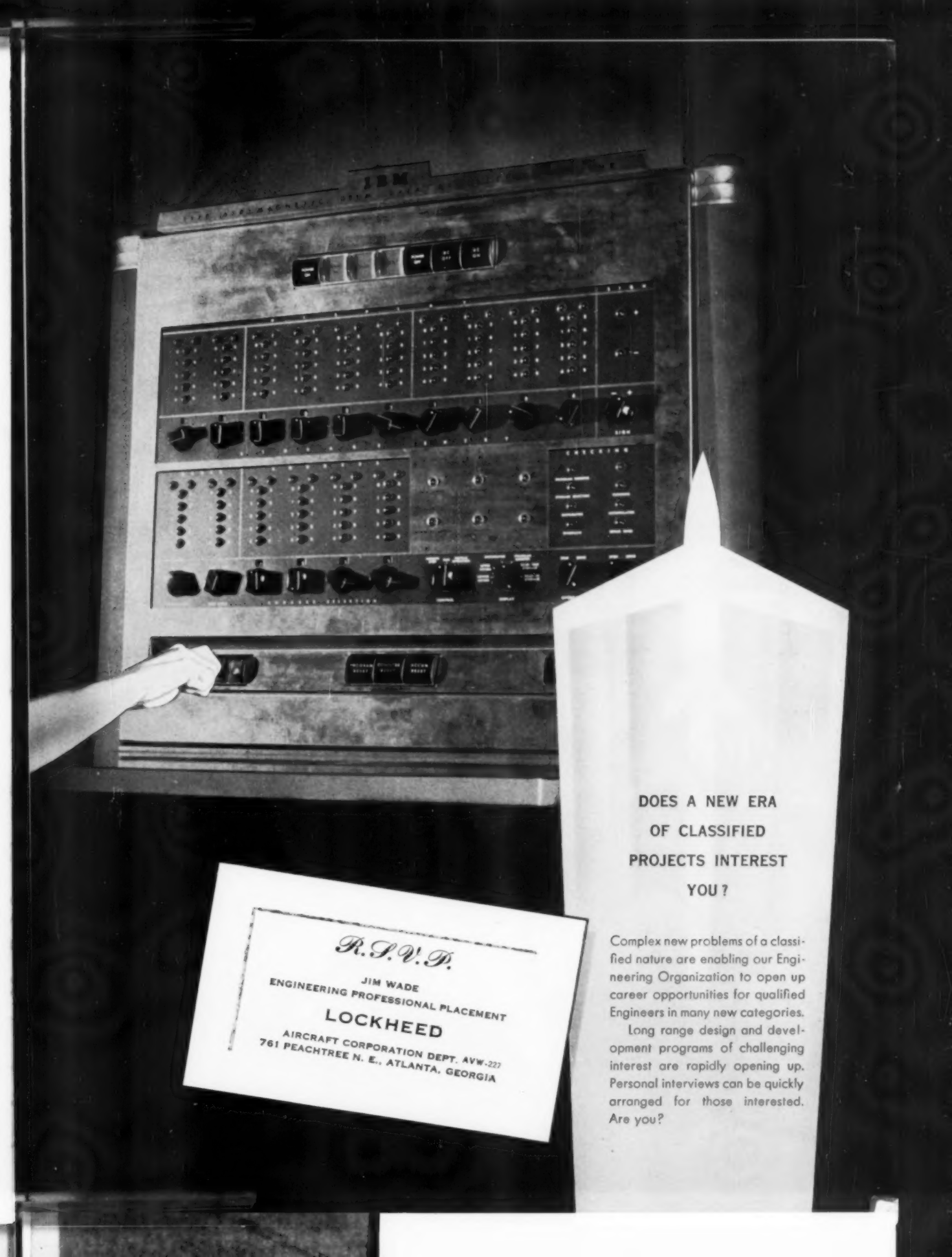

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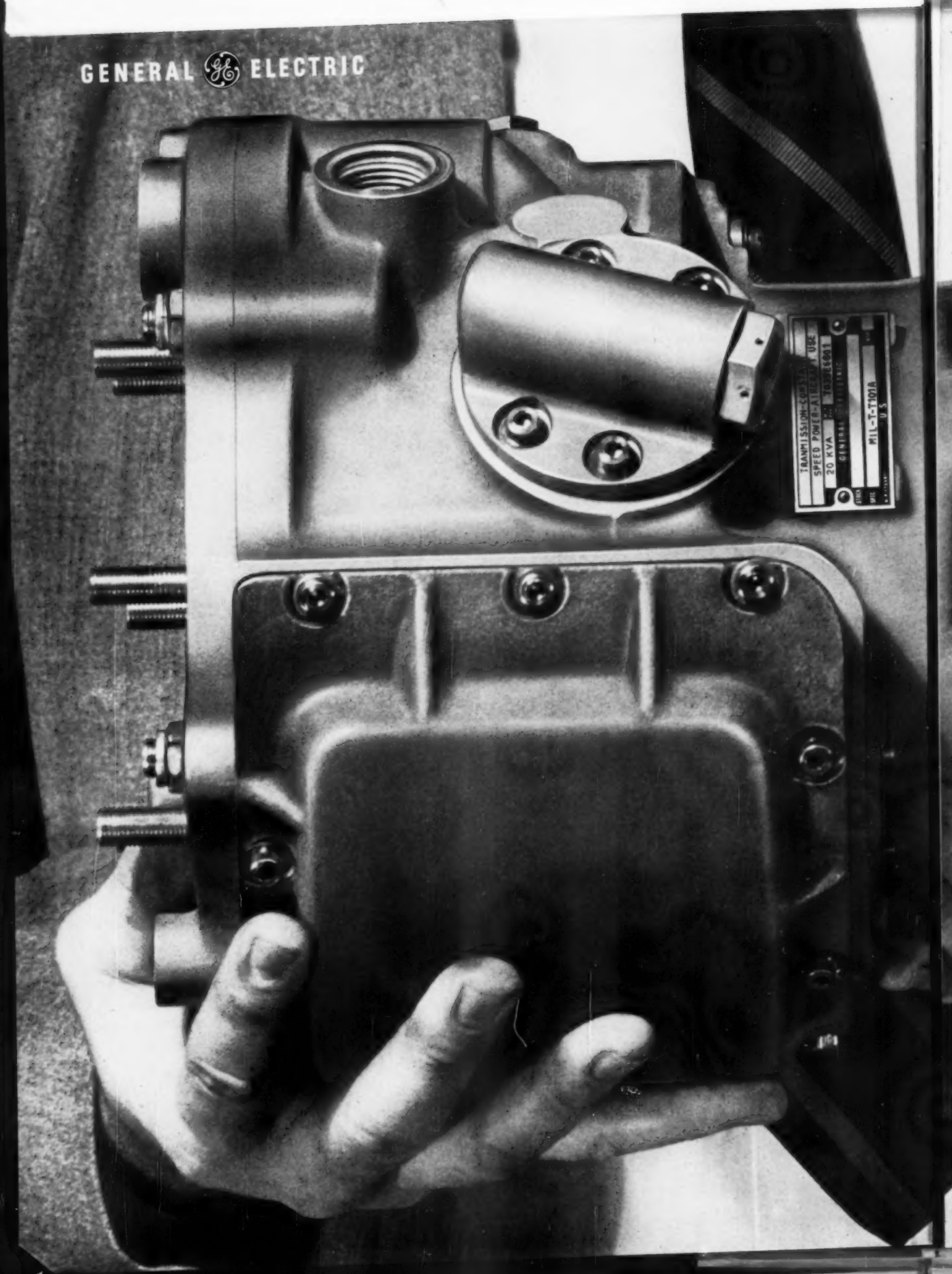
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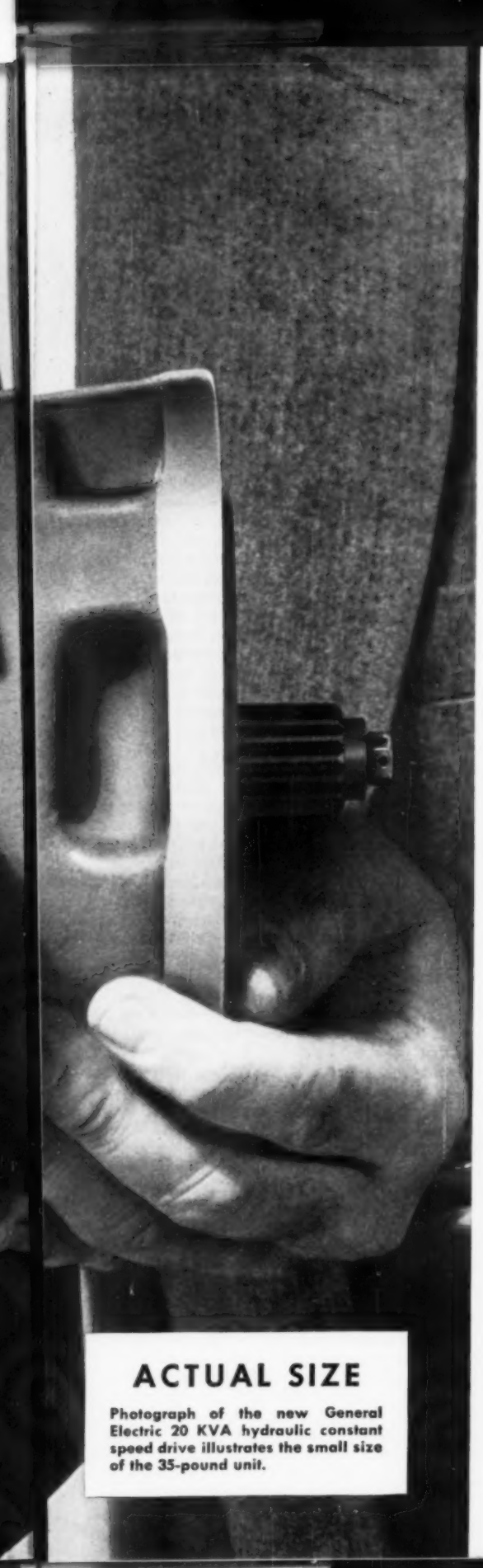

ACTUAL SIZE

Photograph of the new General Electric 20 KVA hydraulic constant speed drive illustrates the small size of the 35-pound unit.

GENERAL ELECTRIC ANNOUNCES

New 20 KVA hydraulic constant speed drive ...weighs only 35 lbs

More and more, equipment on today's aircraft requires constant frequency electric power for optimum performance. To provide more reliable a-c power, General Electric has developed a new 20 KVA hydraulic constant speed drive with a weight of only 35 pounds. This 8000-rpm drive delivers a full 32 hp over an input speed range of 3900 to 7500 rpm. Steady state speed control of $\pm 1\%$ is provided by a built-in mechanical governor and speed control to $\pm 1/10\%$ can be obtained with an additional trimming device. Automatic paralleling can also be provided for two or more drives.

The compact, lightweight design of this 20 KVA drive permits pad mounting (with generator attached) on modern jet engines in most airframe applications.

This new 20 KVA drive has the same service-proven ball piston design as the General Electric 9 KVA drive now operating successfully on the Douglas A4D Skyhawk, currently in production for the U.S. Navy.

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Passenger Copters Favored for Chicago

CAB examiner's report picks Helicopter Air Service, advises denying fixed-wing carrier's application.

Washington—A metropolitan passenger helicopter service has been recommended for Chicago by a Civil Aeronautics Board examiner. Helicopter Air Service is his choice to operate the nation's third passenger helicopter airline.

In his report, Examiner Joseph L. Fitzmaurice favors renewal of Helicopter Air Service's certificate for five years. The new certificate would allow HAS to carry passengers, cargo and mail between Midway Airport and O'Hare Field, and between the two airports and the Loop in downtown Chicago.

Exemption authority for HAS to operate between any points within a 75 mile radius of O'Hare Field is also recommended. The northern boundary of the 75 mile radius could not go beyond Racine, Wisc.

At the same time, Fitzmaurice advised the Board to deny an application of Midway Airlines to operate a local air service in the Chicago area with fixed-wing aircraft. The report was issued in the Chicago Area Service Case.

First Downtown Service

If the CAB follows its examiner's recommendations, HAS will be authorized to operate the first downtown helicopter service with its proposed shuttle between the Loop and the airports. Los Angeles Airways and New York Airways operate in the metropolitan areas of major cities, but neither flies directly to a downtown heliport.

The new service would also answer the increasing need for efficient transportation between the two airports for passengers changing flights at Chicago. The airlines began switching a part of their operations to O'Hare several months ago, and a substantial number of schedules now operate out of the new commercial airport.

In giving the airlines the authority to serve Chicago through O'Hare as well as Midway, the CAB has specified that both airports can't be served on the same flight, leaving passengers traveling between them at the mercy of ground transportation and city traffic.

Need for Service

Fitzmaurice says that the failure to renew HAS with added authority to carry passengers would be a step backward. He feels that passenger authority will permit additional experience with larger equipment, test the practicality of short haul helicopter service and "augment the technical and economic progress of civil aeronautics."

There is a need for improved transportation service between the airports and downtown Chicago, the report said, and air service is the only means of accomplishing it. Midway is about 10 miles and O'Hare 19 miles from the Chicago Loop, and ground transportation through heavily congested areas takes 45 minutes to either airport.

The examiner thinks that a Loop-airport helicopter service would be the best test yet provided to judge the economic feasibility of the helicopter as a transport vehicle. Service into downtown Chicago would be the first operation of this type serving a highly concentrated potential.

The City of Chicago will provide facilities for helicopter service at Midway and O'Hare and it has a project under way to establish a heliport near the central business district.

For a suburban service in the Chicago area, HAS has proposed four routes radiating from Midway Airport to Racine, Wisc., to Kankakee, Ill., to Michigan City, Ind., and also to De Kalb, Ill.

The routes would be a later phase of the carrier's development program and probably wouldn't be served before 1958 or 1959.

Fitzmaurice feels that certificate authority for the suburban service would give a degree of permanency to the service not warranted because of a lack of evidence of the need for it thus far. He recommends a temporary exemption and a flexible area-type authority which will give the carrier a chance to accommodate its services to seasonal shifts and changes in traffic patterns.

Sikorsky S-55 or S-58

The first phase of Helicopter Air Service's new operation would be the triangular shuttle between the airports and downtown Chicago. The carrier plans to use Sikorsky S-55 or S-58 helicopters in the proposed service. New York Airways and Los Angeles Airways both use the S-55 in their passenger operations, and New York Airways has ordered seven of the larger S-58s for delivery this year.

Midway Airlines proposed a passenger and freight service with fixed-wing aircraft. The Midway operation would begin with a shuttle between Midway and O'Hare, and would be expanded to serve points in the Chicago area. The carrier would use Cessna 195 and de Havilland Dove equipment. Midway has operated an air taxi service in the Chicago metropolitan area for five years.

In favoring a helicopter service over a fixed-wing operation, the examiner points out that operation of helicopters between the airports wouldn't raise any congestion problems while an added fixed-wing service would aggravate an already serious problem.

The report points out that the Post Office Department, the Defense Department and the Federal Civil Defense Administration support continuation of helicopter services in the Chicago area. The Post Office Department has been disappointed about the high cost of carrying the mail by rotary-wing aircraft, but it believes that eventually heli-

New York's Heliport Controversy

New York City's heliport controversy (AW Feb. 6, p. 107) was aired last week before a committee of city engineers headed by Deputy Mayor John J. Theobald.

Testifying at the closed session were Port of New York Authority Director Austin Tobin, who proposes a ground-level experimental facility; Commissioner of Marine and Aviation Vincent O'Connor, who wants a rooftop heliport combined with a freight terminal; helicopter builder Igor Sikorsky, representatives of New York Airways, the Civil Aeronautics Administration and the Air Transport Association.

Sikorsky, New York Airways, the CAA and ATA all have previously expressed approval of the Port Authority's plan. CAA recently endorsed it officially and disapproved the city proposal for use as planned by New York Airways.

The committee will report to New York's Board of Estimate, who then may finally take action on a hassle that has delayed construction of the badly-needed facility for more than two years.

copters will benefit the mail service.

The Defense Department favors expansion of helicopter services because of the valuable operations and maintenance experience they develop.

The examiner referred to the 1954 Civil Air Policy Statement in support of helicopter operations. He points out the group found that exacting service in scheduled commercial operations develops new economies and techniques for military use.

Helicopter Air Service has carried mail in the Chicago area since mid-1949. The present system, certificated for an experimental five year period, includes a shuttle between Midway and the Chicago Post Office and suburban routes to Waukegan, Elgin and Joliet, Ill., Gary, Ind. and other points. The Chicago Area Service Case revolves around the HAS application for renewal of its certificate.

The CAB has authorized temporary passenger operations at Los Angeles and New York. The authority of Los Angeles Airways comes up for renewal next September and New York Airways' authority expires in March of 1957.

Subsidy for the helicopter experiment has been about $2.6 million annually for the past two fiscal years. It is estimated at about $2.8 million in Fiscal 1957 and Fiscal 1958.

Helicopter Air Service's subsidy has declined slightly from $432,000 in Fiscal 1954 to $421,000 in the current fiscal year. Subsidy for Los Angeles Airways has risen from $684,000 in 1954 to $952,000 this year, and New York Airways' subsidy has fallen off slightly from $1,458,000 in 1954 to an estimated $1,441,000 in the current fiscal year.

New Message Code Used by Airlines

U. S. domestic and international scheduled airlines are to begin use of a new air reservations interline message procedure (AIRIMP) this week.

AIRIMP, which has a complete grammar and vocabulary of its own, packs all possible reservations messages into 99 short abbreviations. The older Universal Interline Reservations Code which it replaces had 340 code words.

The latest procedures were developed last year by a joint panel of reservations and communications experts of the Air Traffic Conference of the Air Transport Assn. and the International Air Transport Assn. Traffic conferences of both organizations agreed to make the procedure universally effective on Apr. 1, but AIRIMP actually will be used one month earlier to help speed handling of heavy Easter holiday bookings.

Limits on Civil Transportation Of Military Detailed by Defense

Washington—Load limits and service standards for transportation of military personnel in commercial aircraft have been established by the Department of Defense.

The new policy directive sets up detailed standards of service for airlines carrying military personnel in civil air movements (CAM). Defense also has published a table of maximum loads for various types of aircraft used by the carriers for CAM traffic (box, below).

Defense said it prescribed load limits to prevent overloading and to avoid the necessity of carriers refusing part of a load at departure time because it has overbid the capacity of its aircraft.

The load limits are also designed to prevent "hedge-hopping" flights which make frequent fueling stops because of heavy loads and put the loaded aircraft through critical landing and takeoff zones several times on one flight.

The CAM load limitations are based on an average of 66 lb. of luggage and a 160 lb. weight per passenger. Extra crews carried by the airlines must be included in the passenger limitation. When baggage weight is materially reduced, the number of passengers can be increased up to 50% of the difference between actual and allowed weights.

Airlines carrying military personnel must furnish upholstered reclining seats with removable sanitary headrest covers. They are also supposed to furnish blankets and pillows on long flights. A flight attendant is supposed to be assigned to each flight.

The policy directive requires that the airlines serve hot meals in the morning and evening and a box lunch at noon. The meals are supposed to be "fresh, tasty and adequate in quantity." Breakfast is supposed to be served between 0700 and 0800 hours, lunch between 1200 and 1300 hours and dinner between 1700 and 1800 hours. Local time at the origin point governs the first meal period.

Defense doesn't want carriers to furnish monetary allowance instead of meals, and specifies that meals the airlines are responsible for must be furnished at their expense.

In the case of interruption of service on the airlines, they must provide alternate transportation at their own expense and in lieu of a refund. In such cases, the carriers have to pay for reasonable food and lodging during delays unless military authorities volunteer to pay.

Alternate transportation is supposed to be provided in similar equipment if possible. If it is not available within six hours, other air or surface transportation should be provided under the terms of the directive. Sleeping-car accommodations are specified if the delay means passengers will make an unplanned trip between midnight and 6:00 a.m.

If a carrier has to delay or cancel departure of a contracted CAM for a reason other than weather, military order or other conditions beyond its control, it has the same responsibilities specified for delays en route.

Baggage and military impedimenta can be carried without weight allowances as long as they stay under maximum aircraft load limits. Loading and unloading of baggage is a responsibility of the carrier, except that where normal baggage facilities aren't available, passengers can carry it to and from the aircraft.

The carrier is supposed to notify the transportation officer of time and position of departure so passengers can arrive at the airport an hour before flight time.

Airworthiness of aircraft, crew proficiency and operating standards are left to the regulations of the Civil Aeronautics Board and the Civil Aeronautics Administration. Transportation officers are not supposed to inspect aircraft for safety and airworthiness, except to point out any obvious deficiency.

Defense prefers that the airlines use pressurized equipment in operating CAMS, other factors being equal.

CAM Load Limits

Type of Aircraft	Normal Crew	Maximum No. of Passengers	Weight of Passengers & Bagagge (in pounds)
DC-3 or C-47	3	22	5,000
C-46	3	40	9,000
Convair 240	3	36	8,100
Convair 340	3	40	9,000
DC-4 or C-54	4	67	15,000
DC-6	5	80	18,000
Constellation	5	84	19,000
DC-7	5	60	14,000

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See for yourself why experienced air travelers are saying TWA's new Super-G Constellations are the finest planes in the skies.

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Plan to enjoy this luxury on your next trip. Fly TWA's Super-G Constellations nonstop coast to coast, non-stop between major U.S. cities, and now non-stop to Europe. For immediate reservations, see your TWA travel agent or call TWA, Trans World Airlines.

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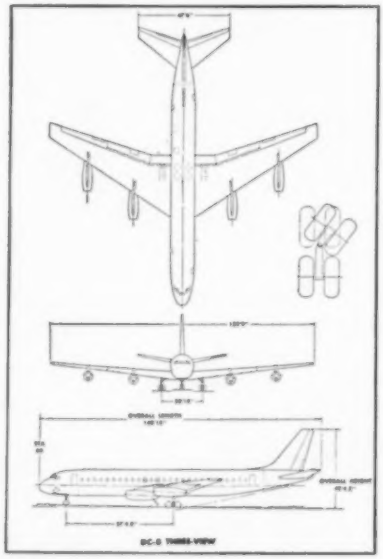
Fly the finest... **FLY TWA**

TRANS WORLD AIRLINES

U.S.A.-EUROPE-AFRICA-ASIA

Douglas Announces New DC-8 Design



Douglas Aircraft Co.'s new DC-8 (AW Feb. 20, p. 30), which supplants earlier paper designs of the jet transport, will be offered in both domestic and extended-range intercontinental versions.

Both versions will have the same dimensions—148 ft. 10-in. fuselage, 139 ft.-9 in. wingspan and 42 ft.-4 in. clearance height.

The intercontinental version will differ from the domestic only in the structural modifications necessary for its added fuel capacity (21,615 gals. for the intercontinental; 17,600 for the domestic).

These include thicker skin and stringer material within the wing structure, aft portion of the fuselage and horizontal stabilizer. The landing gear also is heavier.

The domestic model, Douglas says, will gross 265,000 pounds maximum and carry up to 122 passengers in a first-class configuration with a range of 4,030 miles. With Pratt & Whitney J75 engines, a takeoff runway of 8,640 ft. will be required. This increases to 9,440 ft. if Pratt & Whitney J51s are used; 9,000 ft. with the Rolls-Royce Conway by-pass in the long-range model.

The extended-range version will be able to carry as many as 132 passengers in a mixed first-class and tourist configuration, according to Douglas. All-tourist cabins will accommodate up to 144 passengers. Operating range will be up to 4,810 miles with the Rolls-Royce Conway.

A Douglas spokesman said the latest DC-8 specifications were the result of six months of negotiations with airline customers.

Douglas DC-8 Specifications

DATA APPLICABLE TO ALL MODELS

Wing Area	2758 sq. ft.
Wing Span	139' 9"
Overall Length	148' 10"
Overall Height	42' 4"
Wing Sweepback @ 25% Chord	30°
Landing Gear Type (Swivel Caster)	Dual Tandem
Turning Radius (for wing tip clearance)	91' 1"
Lower Cargo Compartments (2) Total Volume—Both Compartments	1445 cu. ft.

*DATA APPLICABLE TO SPECIFIC MODELS LISTED

		Domestic First Class	Domestic First Class	Intercontinental (Mixed 1st Class-Tourist)	Intercontinental (Mixed 1st Class-Tourist)
Engines		JT3c-4 (J-57)	JT4A-3 (J-75)	**JT4A-3 **(J-75)	Conway
Design Gross Weight	lbs.	265,000	265,000	287,500	287,500
Max. Usable T. O. Weight	lbs.	250,000	265,000	287,500	287,500
Design Landing Weight	lbs.	189,000	189,000	190,500	190,500
Manufacturer's Weight Empty	lbs.	114,489	118,265	120,737	115,877
Operating Weight Empty	lbs.	119,726	123,532	128,862	123,726
Design Zero Fuel Weight	lbs.	161,200	165,000	167,550	163,750
Fuel Capacity	lbs.	114,400	114,400	140,500	140,500
Fuel Capacity	gals.	17,600	17,600	21,615	21,615
Capacity Payload (Space Limited)	lbs.	34,280	34,280	35,930	35,930
Number of Passengers		122	122	132	132
Cargo	lbs.	14,150	14,150	14,150	14,150
Range	st. mi.	3,550	4,030	4,470	4,810
Reserve Fuel	lbs.	16,500	16,680	17,180	16,800
Cost per Airplane Mile	$/st. mi.	1.54	1.72	1.93	1.835
Cost per Seat Mile	¢/seat mi.	1.26	1.41	1.46	1.39
Level Flight Speed Max. Cruise Thrust (a) at 30,000 ft., at 220,000 lbs	MPH T. A. S.	561	586	586	582
(b) at 30,000 ft., at 200,000 lbs	MPH T. A. S.	568	——	——	——
CAA Field Length Req'd for T. O. at Max. T. O. Weight	ft.	9,440	8,640	8,760	9,000
CAA Field Length Req'd for Ldg. at Max. Ldg. Weight	ft.	6,680	6,630	6,690	6,690
Range with 6500 ft. T. O. Field Length	(st. mi.)	1,830	2,650	3,060	3,280
TOURIST VERSION					
Capacity Payload Space Limited	lbs.	37,910	37,910	37,910	37,910
Number of Passengers		144	144	144	144
Cargo	lbs.	14,150	14,150	14,150	14,150
Range	st. mi.	3,290	3,790	4,330	4,670
Cost per Seat Mile	¢	1.07	1.19	1.34	1.27
Range with 6500 ft. T. O. Field Length	(st. mi.)	1,770	2,495	2,960	3,190

* All range and performance data pertains to specific payload and weights indicated.
** Advanced rating.

ALPA Safety Forum Slated Next Month

The Fourth Annual Air Safety Forum sponsored by the Air Line Pilots Assn. is to be held in Chicago on Mar. 6, 7 and 8 at the Hotel Shoreland.

The program for the three-day session stresses the need for better air traffic control to minimize the mid-air collision hazard, the need for further airport development, and other operational problems with which the airline pilots are concerned in their responsibility for safe operation of the nation's airline fleet. Two panel sessions are scheduled, one on air traffic control, present and future, and one on airport safety.

Charles J. Lowen, Administrator of Civil Aeronautics, will address the safety experts and aviation specialists.

The Safety Forum has had three broad general purposes since the first meeting was held in 1953:

- **To insure** study of vital projects.
- **To analyze** what has been accomplished in the field of air safety and what must be done to maintain an acceptable level of safety.
- **To provide** an exchange of views between pilot safety experts and top industry and Government representatives.

THE BIG STORY

Less than two million days have passed since man's first crude attempt to correlate his thinking and his knowledge with a new science of symbols and hieroglyphics.

And communication is still one of our most undeveloped sciences.

Today, something of great importance is happening at Martin in the technology of communication. It is a new method of harnessing and efficiently utilizing engineering mindpower for the solution of previously impossible design and development problems.

This new operational concept now holds the key to countless closed doors beyond which lie the "impossible" achievements of tomorrow.

Already the Martin concept is revising the calendar and the cost on top-rated projects in the most advanced areas of flight systems development. And the next frontier is space itself.

It is a big story.

Come to Martin if you are interested.

MARTIN
BALTIMORE

CAB Insists IATA Stop Race on Fares

Washington—The Civil Aeronautics Board has compromised on its disapproval of international fare increases, but it still insists that international airlines make their fares more realistic.

The Board has approved an International Air Transport Assn. 10% increase in first class fares on most overseas routes until Sept. 30. At the same time CAB moved its approval of tourist fares back from Dec. 31 to Sept. 30.

The original CAB action disapproving the fare increases caused widespread protests from the airlines and various foreign governments. The new fares go into effect April 1.

The Board said temporary approval doesn't indicate any change in its basic philosophy. It expressed concern over lack of seating standards for first class service, lack of realistic minimum seating densities for tourist service and the absence of charges for luxury services. The CAB said it is opposed to the "giveaway race" which is inflating the costs of air service.

In its decision, the Board outlined a number of steps it would like to have the airlines take. The recommendations are directed primarily toward services on the North Atlantic, but the CAB considers them applicable to the Pacific area too.

First, the Board would like to see a separate charge established for sleeperette seats based on a percentage of the first class fare equal to two thirds of the loss in capacity caused by conversion to sleeperette configuration.

An increase in present charges for berths is recommended so that a berth would cost twice the sleeper seat charge.

The CAB favors a realistic standard of minimum seating densities for all aircraft types in service. The Board would base the standards on densities used in domestic operations with adjustments to cover only the difference in physical operating conditions on international routes.

The Board also feels that basic fare levels should be revised in an effort to eliminate any subsidization of first class service with tourist revenue and reflect savings from application of reasonable maximum standards for the service to be supplied at basic fares.

A warning was voiced that the CAB will not approve beyond Sept. 30 any resolutions which don't reflect the principles it has described. The Board said it realized the difficulties involved in an open rate, but it believes a solution of the problem important enough that it is prepared to accept the consequences of an open rate situation.

PROTOTYPE of the SE.210 Caravelle medium-range jet transport, which Sncase hopes to market in the U. S., lifts its nose into air for takeoff during company flight testing.

French Caravelle on Takeoff

MAIN LANDING WHEELS of Caravelle prototype leave ground. Note mud guards at rear of wheels to protect Rolls-Royce Avon RA29 engines along fuselage from flying debris.

CARAVELLE, which has a cruising speed of 450-mph., takes to air for further evaluation. Later models will be powered by more-powerful Rolls-Royce Conway by-pass engines.

• *Last December, Continental Airlines ordered 12 Vickers Viscount 810-840 aircraft for delivery in 1958. Continental has since increased this order to 15 aircraft with an option for an additional five.*

the new turbo-prop

VISCOUNT 810·840

cruising speeds up to 400 miles per hour!

The new Vickers Viscount 810-840 is designed to cruise up to 400 miles an hour at 20,000 feet. Yet it will be *even more* economical and profitable to operate than the famous Viscount 700 series, which has set new speed and traffic records for progressive airlines all over the world.

The Viscount 810-840, with a capacity of up to 70 passengers, will be the ideal aircraft for medium-haul, high-density routes. Its advantages include higher productivity because of higher speed; expanded seating capacity; greater economy through its advanced Rolls-Royce Dart R. Da. 7 and R. Da. 8 turbo-prop engines; and relatively low first cost.

Behind the new Viscount 810-840 stands the great name of the Vickers Group—internationally famous as makers of aircraft, ships, industrial machinery and precision equipment.

United States Representative: Christopher Clarkson, 10 Rockefeller Plaza, New York 20, N. Y.

turbo-prop VICKERS VISCOUNT

VICKERS-ARMSTRONGS (AIRCRAFT) LTD.
Weybridge, England

Airline Traffic—Fourth Quarter 1955

	Revenue Passengers	Revenue Passenger Miles (000)	Load Factor	U. S. Mail Ton-Miles	Express Ton-Miles	Freight Ton-Miles	Total Revenue Ton-Miles	Per Cent Revenue to Available Ton-Miles
DOMESTIC TRUNK								
American	1,826,292	1,072,041	67.21	5,180,739	3,298,763	19,116,235	131,659,297	62.08
Braniff	413,927	155,013	59.83	486,716	428,468	921,193	16,665,480	54.09
Capital	623,941	198,806	59.29	772,487	797,527	1,114,845	21,677,123	45.07
Colonial	94,090	23,217	47.96	47,078	26,636	105,508	2,370,902	48.53
Continental	160,566	58,619	52.08	226,543	88,737	354,191	6,280,578	45.24
Delta	519,289	228,357	60.83	909,533	816,219	1,825,372	25,453,716	57.45
Eastern	1,648,448	822,724	57.14	2,809,324	1,664,358	4,102,391	93,338,401	46.40
National	278,658	188,475	58.28	946,518	222,317	1,227,656	21,598,212	58.90
Northeast	126,581	25,332	58.66	40,299	53,194	77,746	2,498,658	57.86
Northwest	292,511	194,959	57.94	1,289,612	787,090	2,028,651	23,455,838	52.80
Trans World	969,145	739,678	63.09	3,527,092	2,688,583	7,027,149	84,007,381	59.24
United	1,312,888	886,161	63.18	7,079,815	3,843,899	8,948,264	104,963,232	56.45
Western	272,139	127,468	56.10	787,319	256,996	619,138	13,838,834	53.69
INTERNATIONAL								
American	30,147	20,793	63.25	37,869	1,275	697,611	2,925,530	64.88
Braniff	7,634	16,358	34.04	109,620	.....	228,340	2,210,877	36.64
Caribbean Atlantic	31,968	2,464	50.50	3,899	.....	10,784	239,083	48.27
Colonial	5,113	3,972	45.40	392	.....	16,217	449,155	49.27
Delta	11,891	13,342	45.22	26,758	.....	203,140	1,601,512	38.92
Eastern	43,999	61,403	55.39	267,836	.....	258,744	7,139,659	50.89
National	25,385	14,244	52.76	27,184	11,814	133,217	1,645,975	51.53
Northwest	22,532	43,542	48.03	3,399,481	57,110	1,959,339	10,138,092	65.89
Pan American								
Alaska	17,383	27,381	62.78	132,161	.....	779,849	3,780,962	54.25
Atlantic	196,006	238,122	58.19	3,376,411	.....	6,173,896	34,795,902	61.34
Pacific	57,237	167,498	65.31	3,853,069	.....	3,653,443	25,320,701	66.09
Latin America	245,365	222,776	57.75	1,122,275	.....	9,613,136	32,838,739	58.80
Panagra	33,269	38,381	53.65	151,145	.....	712,572	5,076,720	52.60
Trans World	50,372	127,653	55.81	2,836,133	.....	2,380,534	18,957,425	67.22
United	18,093	45,755	67.89	376,304	.....	134,781	5,215,206	63.24
LOCAL SERVICE								
Allegheny	84,276	13,735	43.87	33,299	60,549	.....	1,403,488	45.29
Bonanza	28,251	6,210	39.10	62,385	7,242	15,003	669,987	37.89
Central	23,367	4,171	29.64	14,193	6,342	15,628	434,382	27.01
Frontier	41,290	10,673	41.60	56,229	23,384	154,736	1,254,172	57.34
Lake Central	29,962	4,630	34.78	6,273	42,231	.....	486,702	34.65
Mohawk	81,701	14,880	51.43	16,638	21,851	25,177	1,481,437	51.21
North Central	110,100	16,467	49.12	59,273	97,947	.....	1,725,585	42.54
Ozark	68,050	10,337	35.32	25,133	53,773	.....	1,045,042	36.21
Piedmont	93,948	17,986	51.93	49,622	39,118	48,455	1,856,533	52.60
Southern	42,907	7,398	43.70	27,837	42,163	.....	776,936	42.44
Southwest	64,079	12,969	53.28	22,662	14,338	32,549	1,305,002	52.57
Trans Texas	41,088	9,361	39.92	49,820	20,776	41,901	1,004,272	37.48
West Coast	46,275	8,280	40.59	17,789	6,790	15,996	797,964	48.10
HAWAIIAN								
Hawaiian	91,602	12,415	56.51	14,449	.....	380,608	1,513,252	51.91
Trans Pacific	41,203	5,233	47.10	4,480	.....	27,697	441,267	47.70
CARGO LINES								
Aerovias Sud Americana	.....	.....	.....	.....	.....	2,040,120	2,040,120	61.17
Flying Tiger	16,990	48,708	83.19	45,980	.....	17,908,109	22,824,684	77.11
Slick	4,526	10,114	76.90	109,369	.....	16,911,277	18,032,067	75.10
Riddle	.....	.....	.....	32,015	.....	4,414,056	4,446,071	89.68
HELICOPTER								
N. Y. Airways	7,314	145	63.88	3,327	4,425	1,492	22,627	55.95
Los Angeles Airways	1,587	61	25.10	10,580	3,894	.....	19,705	38.58
Helicopter Air Service	.....	.....	.....	6,957	.....	.....	6,957	41.72

Compiled by AVIATION WEEK from Airline reports to Civil Aeronautics Board.

NEW DEVELOPMENTS *IN* SUPERSONIC AIRCRAFT *CREATE* MANY ENGINEERING OPPORTUNITIES

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Flutter Aeroelastic and flutter analysis now being conducted on current and advanced designs of supersonic airplanes. Experience and capability in independent flutter analysis projects required. Advanced degree desired, but not necessary for man with adequate background.

Electronics Analog and Digital computer experience required. Formulate and solve aeroelastic problems. B.S. degree desired.

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NORTH AMERICAN AVIATION, INC.

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

CAB Orders

(Feb. 9-Feb. 15)

GRANTED:

Pan American World Airways authority to suspend service at Charlotte Amalie, St. Thomas, Virgin Islands, until airport facilities are developed adequate for DC-6B aircraft.

Capital Airlines permission to serve Chicago through O'Hare Airport, providing O'Hare and Midway Airport are not served on the same flight.

Defense Air Transport Administration and the Department of Defense permission to discuss an agreement between various carriers and the Air Force relating to the Civil Reserve Air Fleet program.

Cordova Airlines an extension of its exemption authority to operate between Chitina and Fairbanks, Alaska, via Copper Center, Gulkana, Gakona and Paxons, provided Cordova doesn't schedule flights between Anchorage or Seward and Fairbanks, and doesn't schedule nonstop flights between Cordova and Fairbanks. The authority is effective until 60 days after a decision is reached on Cordova's application for certificate amendment in the investigation of Intra-Alaska air services.

Slick Airways an exemption to charter a DC-6A aircraft to Riddle Airlines.

Braniff Airways permission to serve Chicago through O'Hare Airport, providing O'Hare and Midway Airport are not served on the same flight.

Southwest Airways authority to suspend service at Palmdale-Lancaster, Calif., until the airport facilities are available for use by Southwest.

Seaboard and Western Airlines an exemption to continue operations as a large irregular carrier for 90 days or until 30 days after rights have been obtained for Seaboard to operate scheduled services over its certificated route, whichever occurs first.

APPROVED:

Agreements between various air carriers adopted by the International Air Transport Assn. relating to North Atlantic specific commodity rates.

Agreements involving Pan American World Airways, Canadian Pacific Airlines and various other carriers relating to intercarrier arrangements.

ORDERED:

Southwest Airways' certificate amended to allow the carrier to serve Walla Walla, Wash., and other points on Segment 6 on flights to McCall, Idaho.

Consolidation of several dockets with the Intra-Alaska air service investigation, and inclusion of a review of Part 292 of the Economic Regulations.

Bonanza Air Lines' application for Las Vegas-Bakersfield service included in the reopened Bonanza renewal case.

DISMISSED:

Postmaster General's petition to amend the trunk line service mail rate order, since the Board finds amendment is unnecessary.

Southwest Airways' petition for reargument or rehearing in the Southwest renewal case, since the Board regards it a successive petition for reconsideration. Vice Chairman Joseph P. Adams disagrees with the majority and would consider the petition.

DENIED:

Petitions for reconsideration of a CAB decision denying exemption authority for service between Charlotte, N. C., and Chicago filed by the City and Chamber of Commerce of Charlotte, Delta Air Lines and Eastern Air Lines.

Wide-Step Loading Stand

This aircraft loading stand has four-foot-wide steps permitting faster embarking or disembarking of passengers. Adjustable folding steps in the top platform allow the stand's height to be adjusted to any DC-6, DC-7 or Constellation-type plane. The stand is mounted on 14-in. wheels for easy handling and weighs 1,250 lb. The stand is manufactured by the Aircraft Equipment Co., Box 305, Miami, Fla.

Shortlines

► **Allegheny Airlines** started its first air freight service this month. Service was inaugurated at 15 stations and will be expanded later . . . Allegheny has decided to go back to reconfirmation Mar. 1.

► **Aquila Airways** has been authorized to operate a new flying boat service between Southampton and Las Palmas in the Canary Islands. The service will be operated by-weekly with Short Solent equipment.

► **Cambodia** has become the 67th member of the International Civil Aviation Organization.

► **Jordan's Civil Aviation Dept.** has allocated about $400,000 for development of the Amman Airport this year. The staff will be increased substantially to improve night operations.

► **Lai**, the Italian airline, has announced a five-year expansion program calling for more flights between Rome and New York and extension of its Rome-Teheran service to Calcutta and Tokyo. Lai says it will be operating turboprops on the North Atlantic in 1957 and turbojets in 1960. The Italian carrier didn't specify what types of turbine aircraft it will use.

► **Lufthansa**, the German airline, will add a third daily flight to London in April.

► **Miami International Airport** handled more than 3 million passengers last year, including 783,351 international and 2,275,791 domestic passengers.

► **Netherlands Government** has decided to buy a Fokker F-27 for the use of the royal family to replace the Dakota they use now.

► **Pan American World Airways** is trying out an oral baggage declaration scheme with the U. S. Customs Service. A six week test is being made at Miami on certain flights from the Caribbean and South America in which a passenger declaring not more than $100 in purchases, a gallon of alcoholic

beverages or 100 cigars can make an oral declaration if he has been out of the country 48 hours. This category covers 75% of returning residents, according to PAA.

► **Phoenix** will get local airways traffic control when a planned city-federal project at Sky Harbor Airport is completed.

► **Riddle Airlines** started air express service this month under authority granted last November in the North-South air-freight case.

► **Sabena,** the Belgian airline, has decided to buy another Boeing 707 Intercontinental jet transport for delivery in June 1960. The order will give Sabena a total of four 707s.

► **Seaboard and Western Airlines** flew 1,096,000 freight ton miles in January, an increase of 20% over January, 1954.

► **Silver City Airways** will start serving the Channel Islands from England this month with a daily flight carrying freight, vehicles and up to six passengers.

► **Swissair** has signed an interline agreement with Aeroflot, Russia's state-owned airline. The two airlines have common terminal points at Prague and Vienna.

► **Turkish Airways** aircraft will be repaired at Bedek maintenance plant in Israel under an agreement negotiated between the two countries. The American-operated plant is owned by the Israeli government.

► **United Air Lines** reports record traffic figures for January, with 328,289,000 passenger-miles, a 14% increase. Express traffic was also up 14%, freight rose 7% and mail traffic increased 10.5%.

► **Vancouver International Airport** handled 654,000 passengers last year and made $363,700 from landing fees and other charges. The airport turned over a $137,000 profit to the City of Vancouver.

► **United Air Lines** is substituting its new DC-6Bs for DC-6s in coach service to Honolulu from Los Angeles and San Francisco. The DC-6B coaches carry 75 passengers in two-abreast seating. By March 23, United plans to operate all 12 of its weekly coach flights to Hawaii with DC-6B equipment . . . United now offers an advance payment car rental plan in conjunction with Avis Rent-a-Car system at all points served.

COCKPIT VIEWPOINT

By Capt. R. C. Robson

The Communications' Burden

To control air traffic it is necessary to receive position reports from aircraft. To achieve closer spacing, in areas of heavy traffic, these reports must be more numerous. From the pilots viewpoint, however, these radio contacts can be so numerous as to seriously encroach upon time needed for other cockpit duties.

In an effort to illustrate this matter, I again turn to the New York area. I bear no special grudge against this region; it is simply a question of using situations of which I have first-hand knowledge.

Take a flight from Washington, D. C. to LaGuardia Field. You are over the Freehold (N. J.) fan marker—42 miles southwest of LaGuardia—a normal reporting point. Next, the flight may proceed to the Colts Neck omnirange (10 miles beyond Freehold) and thence to the Flatbush fan marker.

Harried Tuning

But occasionally ATC will direct the pilot to LaGuardia via the southwest course of the LGA low frequency range (Green Airway 3) which intersects Freehold. Now the flight will not pass directly over the Colts Neck omni so the pilot may be asked to report over Regan intersection. In order to report Regan, the pilot must tune to the Allentown LF range.

A map shows that Regan is located about 3.7 miles past Colts Neck on the LF airway. But this is a theoretical map location. Actually, due to the width of the Allentown "leg," the omni and Regan are nearly inseparable. Timewise, the two points are perhaps 45 seconds apart.

The question arises, "Why can't we forget the theoretical 45 seconds and eliminate a cockpit chore (tuning to Allentown) by simply reporting Colts Neck?" At this point, the flight is only a few minutes from LGA and additional radio tuning is not welcomed.

Two or three minutes later the flight may be asked to report over Coney Island intersection. Coney is theoretically 4.4 miles from Flatbush. Contact must be made with LaGuardia approach control prior to Flatbush and with LGA tower at Flatbush. So to report Coney the pilot must tune to the Newark LF range (which he would not otherwise use) at a time when his radios should be positioned for an instrument approach. On top of this he is being asked to report to three different people in the space of a bare one minute!

There is a feeling among pilots that some of these situations could be eased if controllers were aware of the extra burden each report puts on the cockpit. In some cases radio simply can't be re-tuned fast enough to keep up with requested communications.

Diminishing Returns

Each route is flown by use of certain "normal" radio facilities and over the years various reporting points have become "standard."

A pilot must plan ahead and determine which facilities he must tune to and the sequence of this tuning. When ATC requests a report which requires tuning to an "unnatural" station, or when pilots must locate an "obscure" place on a map extra time is involved.

Since our communications system is overloaded today, with no immediate relief in sight, is it not possible that the situation could be eased by whittling here and there? For instance, could each center re-examine their requirements and make sure that each report is urgently needed? It is conceivable that in our efforts to move more traffic via frequent progress reports we are actually slowing down the process. We may have created a case of diminishing returns. One thing certain, any reduction in the radio work will certainly be appreciated in the cockpit.

ENGINEERS

NEW 2-FOLD RETIREMENT INCOME PLAN

for Aviation and Missile Engineers

It's natural that a long-time leader in aviation, like Republic—with many firsts to its credit—should be a leader, too, in providing for the welfare of its staff. Right in line with this forward-looking policy is the remarkable new Republic Retirement Income Plan. Here is how it works:

PART 1 *is a basic Retirement Income plan paid for* entirely *by Republic Aviation.*

PART 2 *is a cooperative effort. It is completely optional. But if an engineer wishes to increase his retirement fund, by making a small monthly payment, Republic will* MORE THAN MATCH *his contribution.*

Take the case of a hypothetical engineer who joins Republic on January 1st, 1956, averages $8,000 a year for 15 years; then retires aged 65. If he elected PART 2 of the plan, he will have a total *monthly retirement income of $225.80,* including his social security. For this he himself will contribute *only $8.50 a month* to the Republic Retirement Income Plan.

Of course, the MORE YOU EARN, the HIGHER your Retirement Income will be. And Republic pays a top salary scale in the industry.

...RETIREMENT PLAN JUST ONE OF MANY PLUS FACTORS POINTING TO A REPUBLIC CAREER

FIRST — there's the interest and prestige of working for a pioneer in aircraft design, creator of such famous planes as the F-84 Thunderjet, the F-84F Thunderstreak, RF-84F Thunderflash and XF-84H. (Soon to be followed on the production line by the new F-103, F-105 and RF-105.)

SECOND —the company is expanding sharply, providing frequent opportunities for able men to advance. In fact a $12,000,000 increase in the Research and Development Program has just been announced.

THIRD —an All-Expense Paid Relocation Plan for qualified engineers living outside the New York City and Long Island areas, which makes it easy to move to Republic. Other liberal benefits: Life, Accident and Health Insurance; Hospital-Surgical Benefits for the whole family; educational aid covering ⅗ the cost of collegiate and graduate study.

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- DYNAMICS
- ELECTRO-MECHANICAL DESIGN
- FLIGHT TEST
- RESEARCH
- THERMODYNAMICS
- FLUTTER & VIBRATIONS
- STRESS
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- WEIGHTS
- DESIGNERS: Electrical, Airframe, Mechanical

Please address complete resume outlining details of your technical background to:

REPUBLIC AVIATION

AIRCRAFT
Assistant Chief Engineer, Administration, **Mr. R. L. Bortner**
Farmingdale, Long Island, N. Y.

MISSILES
Administrative Engineer, Mr. Robert R. Reissig
Hicksville, Long Island, N. Y.

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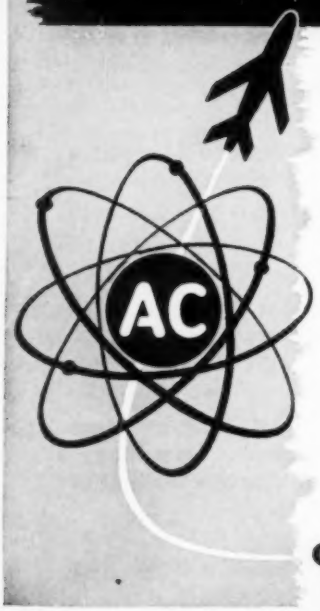

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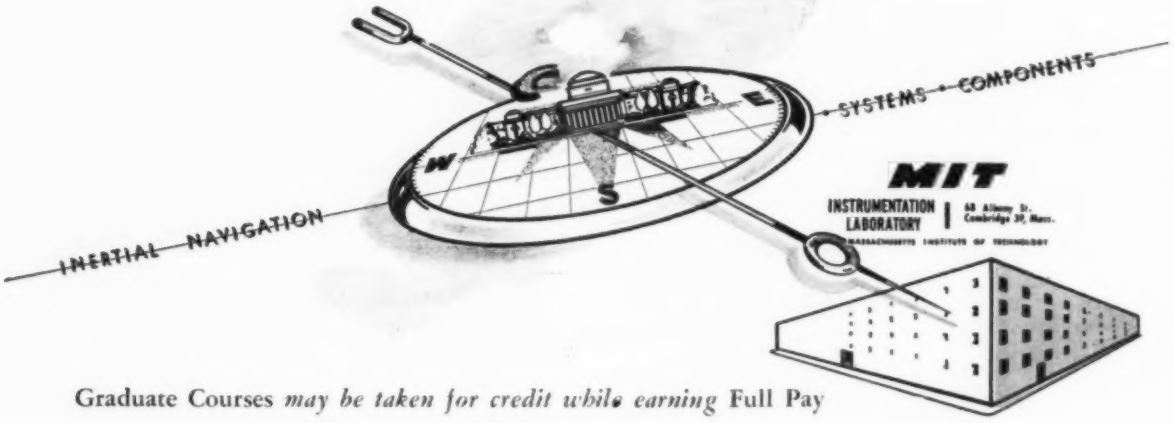

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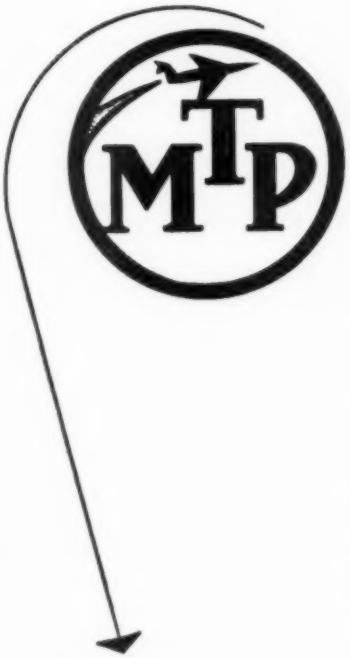

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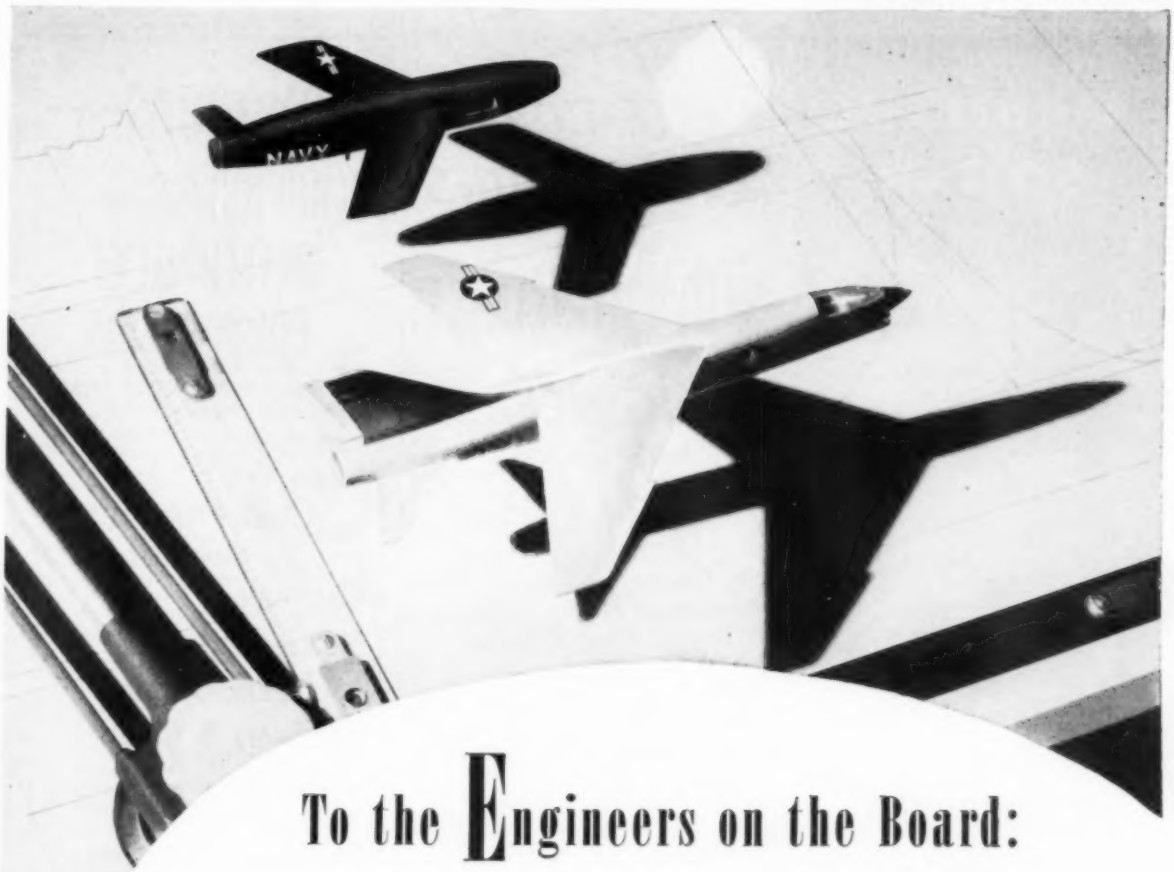

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1700	AM1614-80	Circuit Breaker
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16	LEP-30D	Auxiliary Power Unit
188	EYLC-2334	Control
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122	10-34635	Single Engine Ignition Switch
42	SF5RN12	Magneto
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400	AN5780-2	Wheel & Flap Indicator
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68	828-1JZ-2	Oil Temp. Indicator
36	828-12Z-2	Carburetor Air Temp. Ind.
10	727-70Z-2	Air Temp. Indicator
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140	596946	Ballast Core & Coil
75	P4CA2A	Primer
9	014016-31-16	Coupling
166	38QD1800B	Coupling
371	5QD1800B	Drop Tank Valve
132	8QD1800B	Drop Tank Valve
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10	9530493	Valve
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Quan.	Part No.	Description
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3	401856-3	Valve
8	AA37001	Valve
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33	420313	Pump Assy.
46	416421	Pump Assy.
65	U635A	Fuel Strainer
110000	L84-AD1	Spark Plug
814	74247	Valve
450	78573	Swivel Joint
70	AN3213-1	Ignition Switch
3	AN4103-2	Oil Cooler Valve
358	2301-ON	Thermostat
22	A55A00	Ignition Unit
130	PG208-AS7	Air Ram Switch
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5	M102	Pressure Switch
349	M826	Pressure Switch
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18	SW472083	Heat Exchanger
22	417	Switch
228	IV40-550	Iris Valve
100	c450	Filter
126	11247A	Fuel Gauge
64	11110A	Fuel Gauge
102	11108	Oil Gauge
170	11749	Receptacle
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1018	13018A	Interphone Box
312	19268	Bearing
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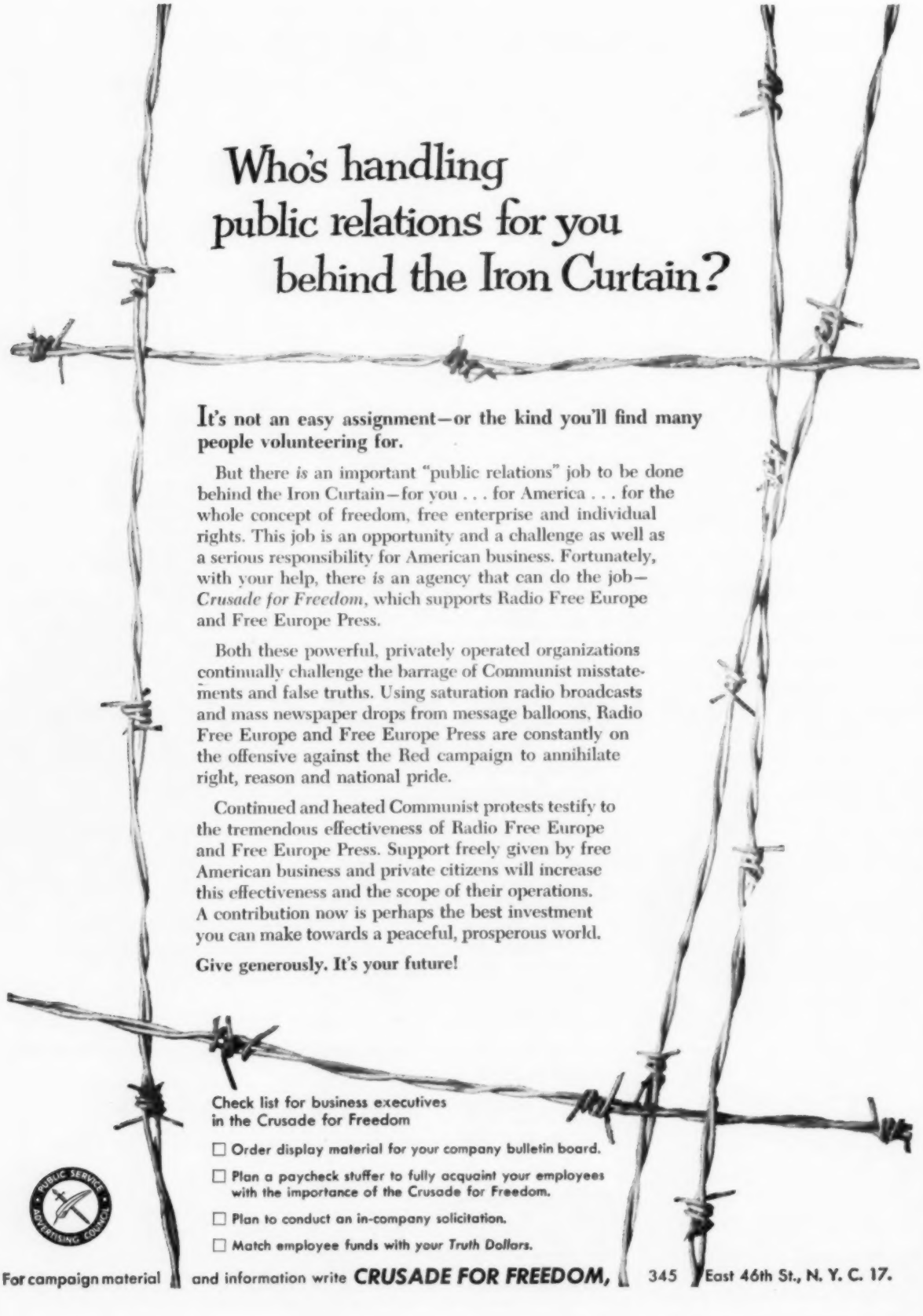

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LETTERS

Dyed Extinguishants

I would like to make some belated comments on the Cockpit Viewpoint from your December 5th issue.

Dyed extinguishant is a definite necessity for accident investigation. The British used it through most of the war period and obtained some valuable information. The dye was designed to stick, but when extinguishers were inadvertently discharged in the post war days, it was a different matter. The time taken to remove the dye from engines and airframe was so great that the civil aircraft operators soon demanded that only clear undyed extinguishant should be used. Captain Robson's idea, though an old one, is worthy of another trial, but—I'll wager!—doomed from the word go.

Captain Robson might well check up on some British fire detectors before condemning today's warning systems as delicate wires too fragile to achieve rugged reliability. Far too many faults in the aircraft electrics are tagged as failures of the associated system—over 90% of so termed false fire alarms are the result of wiring troubles and not the fault of the detecting equipment.

It is difficult to understand how a fire warning system can work too soon!

E. J. White
"Treetops"
Pinewood Road
Virginia Water
Surrey, England

Revised Report

I wonder if your readers realize the tremendous and untiring efforts put forth by the NWA pilots and ALPA officials in "persuading" the CAB to revise their report on the Sandspit accident. This industry cannot progress so long as official accident investigations are concluded with the familiar "pilot error" to explain probable cause. Admittedly, the much abused "pilot error" is the easy out, whitewashing the bureaucratic bungling and designers' defaults—but nothing constructive comes from this type report.

The professional pilots follow CAB accident reports; always hoping to gain a grain of knowledge—perhaps someday destined to prevent another accident. The service your magazine provides in verbatim CAB reports is of utmost value, and we enlist your support in removing the phony and non-constructive probable cause finding the CAB calls "pilot error."

R. F. Adickes, Chairman
TWA Central Air Safety Comm.
1240 Blue Road, Coral Gables, Florida

New Bristol Helicopter

Your issue of January 10, 1956, carried a reference to the Type 191 helicopter saying quite correctly that the orders for this aircraft are to be cut. For the record, may I please make it clear that development of twin-engined general-purpose and transport

Aviation Week welcomes the opinion of its readers on the issues raised in the magazines editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

helicopters for the Royal Air Force continues, derived from the Type 173 design, and a substantial order for these machines has been placed with us. The line of development being followed will also, we believe, interest civil operators.

Peter King
The Bristol Aeroplane Company Limited
Filton House
Bristol, England

Traffic Controller View

As a traffic controller for thirteen years, I feel that our critical problems in this field could be solved if we utilize all the knowledge we have at our disposal. For this reason I would appreciate your printing the following suggestion.

WRONG DOCTOR

Much has been written and spoken in the last few months regarding our air traffic control problems. Many well meaning people have discussed the problems. Consultants have been consulted. Committees galore have wrestled with the problems. However no one as yet has come up with an acceptable answer which is less than X years off.

If we are to solve the problems of traffic control without delay isn't it time we heard from the thousands of air traffic control specialists who do the day-to-day-job of controlling the nation's civil and military air traffic.

CAA should schedule a Jet Age Air Traffic Control Conference of professional air traffic controllers. If these experts had an opportunity to speak on the problems their answers, I feel, would soon resolve the dilemma. This conference should be held under hair down, no gag, no holds barred, all is forgiven, rules. For the first time let's let the traffic controller tell us what they need to get their job done safely.

R. M. Dolder
Attorney at Law
Vienna, Virginia

Auxiliary-Radio Valve

With the superb ground facilities available for guiding lost aircraft in safely, we would be interested in knowing why the Northeast Airlines plane that lost its electric system was not equipped with the simple radio set needed to use these ground facilities. There are several inexpensive self-contained two-way radios on the market that would have prevented this near catastrophe.

Head-on collisions still occur on railroads due to management's refusal to install radio equipment. Is it possible that the airlines are equally short-sighted in not having self-powered auxiliary radio equipment?

Perhaps it only happens "once in a million times." That is once too often if a five lb., $95.00 auxiliary radio would have prevented the incident.

We await the final report on this incident with deep interest, as we believe this "near catastrophe" can possibly explain others that didn't turn out so fortunately.

Omar Midyett, Owner
Aircraft Sales Center & Lakeside Airport
East St. Louis, Illinois

Gnat's Future

Your issue January 16 (p. 23): I would certainly not abandon the Gnat which has a great future nor the team which has helped me to design and develop it while the Folland backing so generously and consistently supplied for 4 years have yet to receive its due reward.

W. E. W. Petter
Folland Aircraft Ltd.
Hamble, Hants

Proprietary Data

Aviation Week of January 23, in reporting on Aircraft Radio Company, mentions the military service's turning over drawings to competitors of aircraft when reordering equipment. The event is startling, but usually it is within the Government's rights when it happens.

In the writer's experience, the situation grows from all the "Specifications" written into the contract. Those primary "specs" embrace additional specs, and soon the contractor's obligations are much bigger than the plain wording of the contract. But it is open and fair.

Drawings are usually required in contracts, and the drawing specification states that there must be "complete remanufacturing information—test specifications, etc." A heavy weight is added with quality control requirements which ostensibly arm the Government inspectors with all data necessary to examine piece parts, sub-assemblies, raw materials—as well as the performance of the finished unit.

To gain a remedy from revelation of "know how" a manufacturer had better step up the thoroughness of his pre-bidding studies, and possibly do some organizational work in the industry and ask that bidding forms be revised by the Government.

The writer believes that if an item is truly proprietary and has originated with a manufacturer, he deserves continuance of his reward. At present, unless a firm investigates all the specifications, line by line, it may have to deliver much more than it expected in know how and man hours.

Thomas E. Bissell
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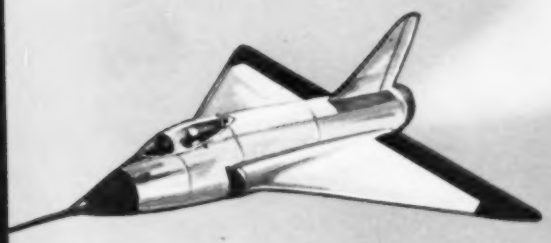
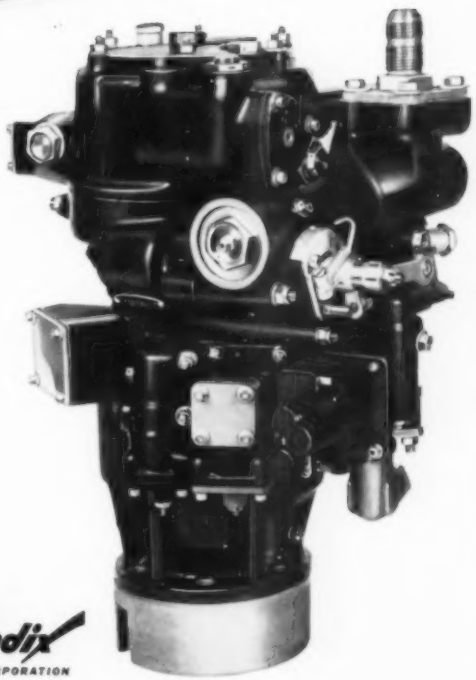


FOR EXAMPLE...

This advanced type fuel metering unit was developed by Bendix to include special features for the 10,000-pound thrust class Pratt & Whitney J-57 turbojet—the engine which puts the power behind the super performance of the F4D Skyray.



As early as 1945, Bendix brought out a jet engine control which automatically metered fuel during engine acceleration and deceleration so as to avoid over-temperature, compressor stall and "flame out". Since then, these features have become a "must" on all jet engine controls, allowing the pilot to slam the throttle wide open without danger of ruining the engine, or slam it shut without risk of "flame out".

Bendix fuel metering is used today on nearly all American airliners, and on a great majority of military aircraft. This includes injection type carburetors and direct fuel injection, as well as fuel metering and complete engine control systems for jets.

These and other achievements are solid evidence that the aircraft industry can continue, as in the past, to look to Bendix for creative engineering and quality manufacturing.

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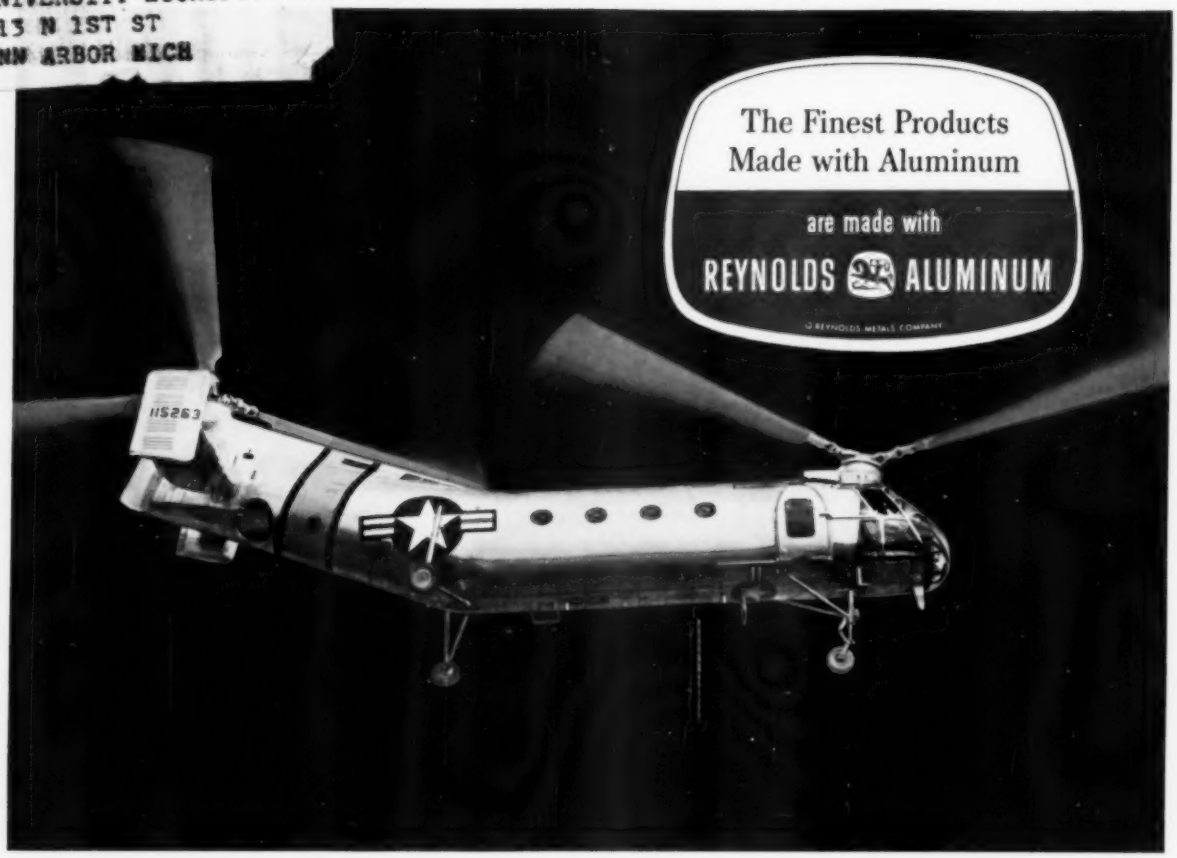

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